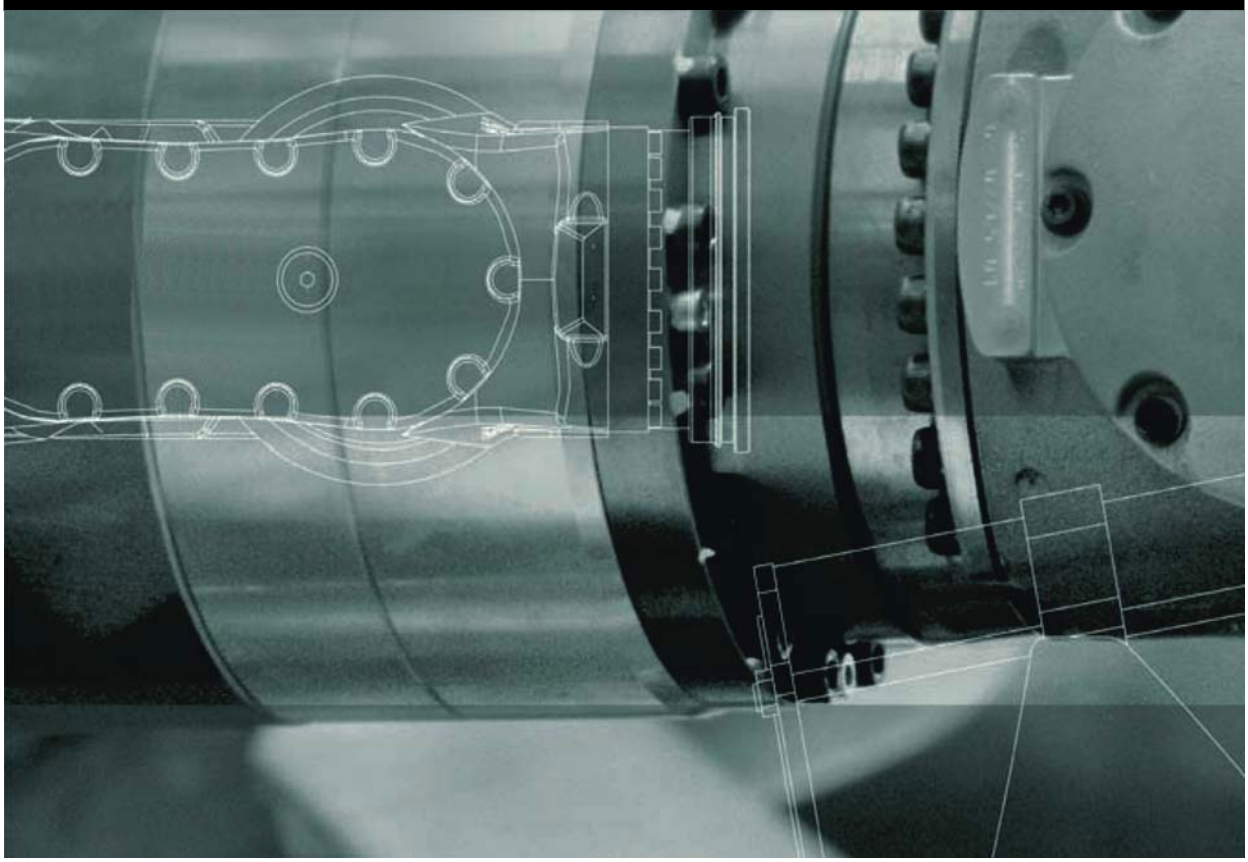
KUKA

KUKA System Technology

KUKA Roboter GmbH

KUKA.LaserTech 3.1

For KUKA System Software 8.3



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Other functions not described in this documentation may be operable in the controller. The user has no claims to these functions, however, in the case of a replacement or service work.

We have checked the content of this documentation for conformity with the hardware and software described. Nevertheless, discrepancies cannot be precluded, for which reason we are not able to guarantee total conformity. The information in this documentation is checked on a regular basis, however, and necessary corrections will be incorporated in the subsequent edition.

Subject to technical alterations without an effect on the function.

Translation of the original documentation

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Contents

1 Introduction

1.1 Target group

This documentation is aimed at users with the following knowledge and skills:

- Advanced KRL programming skills
- Advanced knowledge of the robot controller system
- Advanced knowledge of the laser controller systems
- Knowledge of the other peripheral controller systems (e.g. distance controller)
- Knowledge of field bus interfaces

For optimal use of our products, we recommend that our customers take part in a course of training at KUKA College. Information about the training program can be found at www.kuka.com or can be obtained directly from our subsidiaries.

1.2 Industrial robot documentation

The industrial robot documentation consists of the following parts:

- Documentation for the manipulator
- Documentation for the robot controller
- Operating and programming instructions for the control software
- Instructions for options and accessories
- Parts catalog on storage medium

Each of these sets of instructions is a separate document.

1.3 Representation of warnings and notes

Safety

These warnings are relevant to safety and **must** be observed.

DANGER These warnings mean that it is certain or highly probable that death or severe injuries **will** occur, if no precautions are taken.

WARNING These warnings mean that death or severe injuries **may** occur, if no precautions are taken.

CAUTION These warnings mean that minor injuries **may** occur, if no precautions are taken.

NOTICE These warnings mean that damage to property **may** occur, if no precautions are taken.

These warnings contain references to safety-relevant information or general safety measures.
These warnings do not refer to individual hazards or individual precautionary measures.

This warning draws attention to procedures which serve to prevent or remedy emergencies or malfunctions:

SAFETY INSTRUCTIONS	Procedures marked with this warning **must** be followed exactly.

Notes

These hints serve to make your work easier or contain references to further information.

	Tip to make your work easier or reference to further information.

1.4 Terms used

Term	Description
CrossJet	Gas that keeps the lens of the laser free of dirt.
Laser program	Program executed in the laser controller.
Process gas	The process gas keeps the welding site free from oxygen, thereby protecting the seam against oxidation.
Root gas	Process gas that protects the seam against oxidation from beneath. Only relevant in the case of through-welding of the plate and if gas can be fed in from underneath.

1.5 Trademarks

TruControl is a trademark of Trumpf.

2 Product description

2.1 LaserTech – overview

Functions

LaserTech is an add-on technology package with the following functions:

- Configuration and programming of laser applications (standard LaserTech package)
- Configuration and programming of laser cutting applications (LaserCut)
- Configuration and programming of laser welding applications with/without filler wire (LaserWeld)
- Configuration and programming of up to 3 user-defined laser applications

The backwards movement option is deactivated when working with this technology package.

Areas of application

- Laser cutting
- Laser welding
- LaserTech can be expanded for further user-defined applications, e.g. powder surfacing

KUKA.LaserTech supports the following systems:

- TRUMPF laser controllers
- PRECITEC distance controllers (for laser cutting)

For information about adaptation for systems from other manufacturers, please contact KUKA Customer Support. (>>> 12 "KUKA Service" Page 97)

Communication

The robot controller communicates with the laser controller via a field bus.

2.2 Laser power and path velocity

In LaserTech, a weld program is executed by default with a constant laser power. The variable LSR_UsePwrVelCtrld can be used to configure whether the laser power is regulated proportionally to the robot velocity. This means: if the programmed robot velocity is not reached, LaserTech reduces the laser power accordingly.

The proportionality is restricted by the upper and lower power limits of the laser. The lower power limit of the laser is always > 0, as the laser power cannot be regulated down to 0.

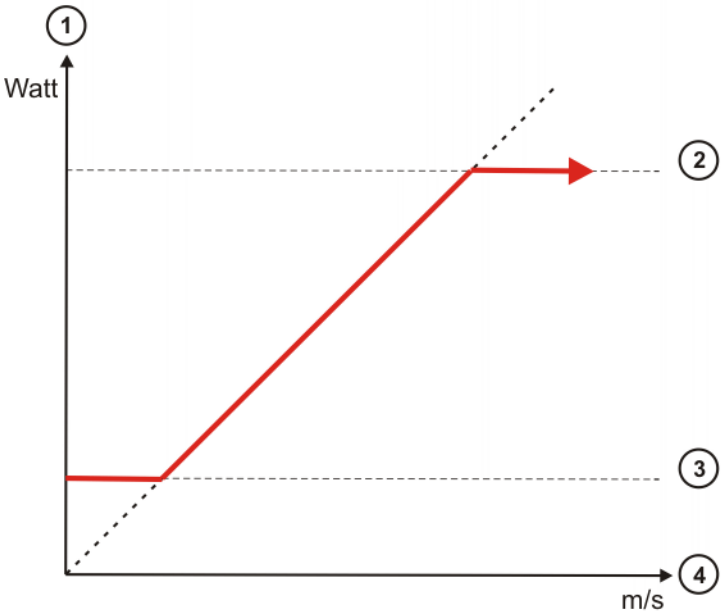

Fig. 2-1: Relationship between velocity and laser power

1 Laser power in watts
2 Upper laser power limit
3 Lower laser power limit
4 Velocity in m/s

2.3 Intended use

Use

LaserTech is intended exclusively for industrial operation in an enclosed cell conforming to the applicable laser protection conditions and safety standards.

The system integrator must ensure that the robot system is installed and operated in an environment that is suitable for laser applications. In particular, it is important to consider the hazards which could arise from incorrect user programming and unintended activation of the laser, e.g. with the result that the laser hits the cell wall or fixture.

⚠ WARNING It must be ensured that no persons are present in the cell when the laser is enabled or active. Severe injuries may otherwise result.

Operation in accordance with the intended use also involves compliance with the start-up and configuration instructions in this documentation.

Misuse

Any use or application deviating from the intended use is deemed to be impermissible misuse. The manufacturer cannot be held liable for any damage resulting from such use. The risk lies entirely with the user.

Examples of such misuse include:

- Bypassing of protective mechanisms such as the safety door and safety circuit of the laser
- Programming the application in a such a way that the enabled laser beam does not hit the intended area, e.g. the workpiece, but the cell wall or fixture.
- Program execution (T2, AUT, EXT) without a workpiece in the fixture. This can result in the laser beam directly hitting the fixture.
- Activation of the laser by setting inputs/outputs in test mode (T1, T2) with the safeguard closed.

- Use in non-industrial systems

3 Safety

This documentation contains safety instructions which refer specifically to the software described here.

The fundamental safety information for the industrial robot can be found in the “Safety” chapter of the Operating and Programming Instructions for System Integrators or the Operating and Programming Instructions for End Users.

The “Safety” chapter in the operating and programming instructions of the KUKA System Software (KSS) must be observed. Death to persons, severe injuries or considerable damage to property may otherwise result.

The safety standards must be observed when working with the laser. Injuries or damage to property may otherwise result. For further information and specification of the laser class, please refer to the documentation of the laser manufacturer.

The safety measures of the laser system must be observed when wiring the system. In particular the EMERGENCY STOP circuit and operator safety must be wired correctly before this software is used. Injuries or damage to property may otherwise result. The safety measures of the laser system can be found in the documentation of the laser manufacturer.

4 Installation

4.1 System requirements

Hardware

- KR C4
- KUKA field bus cards (Interbus or PROFIBUS)
- Specific components for the application

Software

- KUKA System Software 8.3

4.2 Installing or updating KUKA.LaserTech

It is advisable to archive all relevant data before updating a software package.

Preparation

- Copy software from CD to KUKA USB stick.

  The software must be copied onto the stick with the file Setup.exe at the highest level (i.e. not in a folder).

NOTICE Recommendation: Use a KUKA stick. Data may be lost if any other stick is used.

Precondition

- "Expert" user group

Procedure

1. Connect the USB stick to the robot controller or smartPAD.
2. In the main menu, select **Start-up** > **Additional software**.
3. Press **New software**. The entry **LaserTech** must be displayed in the **Name** column and drive **E:** or **K:** in the **Path** column.

   If not, press **Refresh**.
4. If the specified entries are now displayed, continue with step 5.

   If not, the drive from which the software is being installed must be configured first:
   - Press the **Configuration** button. A new window opens.
   - Select a line in the **Installation paths for options** area.

     Note: If the line already contains a path, this path will be overwritten.
   - Press **Browse**. The available drives are displayed.
   - Select **E:**. (If stick connected to the robot controller.)

     Or select **K:**. (If stick connected to the smartPAD.)
   - Press **Save**. The window closes again.

   The drive only needs to be configured once and then remains saved for further installations.
5. Mark the entry **LaserTech** and click on **Install**. Answer the request for confirmation with **Yes**.
6. Confirm the reboot prompts with **OK**.
7. Remove the stick.
8. Reboot the robot controller.

   On rebooting, a reminder is displayed about installing the LaserWeld and LaserCut options. If the reminder should not be displayed again, select **No longer ask**.

During installation of LaserTech, the LaserWeld and LaserCut options are copied to the directory D:\KUKA_OPT. If required, the options must be installed separately from this directory.

LOG file A LOG file is created under C:\KRC\ROBOTER\LOG.

4.3 Uninstalling LaserTech

It is advisable to archive all relevant data before uninstalling a software package.

Precondition

- "Expert" user group

Procedure

1. Select **Start-up** > **Install additional software** in the main menu. All additional programs installed are displayed.
2. Depending on which part of the technology package is to be uninstalled, select the corresponding entry:
   - LaserTech: select the entry **LaserTech**.
   - LaserWeld: select the entry **LaserWeld**.
   - LaserCut: select the entry **LaserCut**.
3. Press **Uninstall**. Reply to the request for confirmation with **Yes**. Uninstallation is prepared.
4. Reboot the robot controller. Uninstallation is resumed and completed.

LOG file A LOG file is created under C:\KRC\ROBOTER\LOG.

5 Operation

5.1 Menus

The following menus and commands are specific to this technology package:

Main menu:

- **Configuration** > **Status keys**
  - **LaserTech**
  - **Laser Cut**

Menu sequence **Commands** > **LaserTech**

- **Switching**
  - **Activate process**
  - **Switch process**
  - **Deactivate process**
  - **Step seam**
  - **Laser test pulse**
- **Control commands**
  - **Initialize laser**
  - **Enable laser**
  - **Laser off**
  - **Laser request**
- **Media control**
  - **Switch gas**
  - **Initialize gas**
  - **Cut wire**
- **Sensor control**
  - **Switch sensor**
  - **Sensor settings**
- **Cutting**
  - **Rectangle**
  - **Slot**
  - **Hexagon**
  - **Circle**

5.2 Basic laser function status keys

Select **Configuration** > **Status keys** > **LaserTech** in the main menu to display the status keys.

For safety reasons, the status keys are deactivated. To activate them, the enabling switch on the smartPAD must be pressed.

The status keys are not available in Automatic External mode.

	Off	On	Inactive	Description
Laser				The status key “Laser off” is displayed: the program is executed without laser power. The status key “Laser on” is displayed: the program is executed with laser power.
Pilot laser				Pressing “Pilot laser off” switches the pilot laser on. Pressing “Pilot laser on” switches the pilot laser off.
Gas				Pressing “Gas off” activates the process gas, root gas and CrossJet. Releasing the status key stops the flow of gas. **Note**: When process gas, root gas and CrossJet is activated, the high pressure of the emerging gas may result in injuries and in material damage to sensitive system components. Do not aim the gas at the body.
Wire				Pressing “Wire off” activates the wire feed. Releasing the status key stops the wire feed. **Note**: Welding wire emerging from the wire feeder can cause injuries to hands, face and eyes. Be sure to maintain a safe distance.

5.3 LaserCut status keys

Select **Configuration** > **Status keys** > **Laser Cut** in the main menu to display the status keys.

For safety reasons, the status keys are deactivated. To activate them, the enabling switch on the smartPAD must be pressed.

The status keys are not available in Automatic External mode.

	Off	On	Inactive	Description
Sensor				Status key “Sensor off” is displayed: the sensor functions are inactive. Status key “Sensor on” is displayed: the sensor functions are active.
Distance control				Pressing “Distance control Off” switches distance control on. Pressing “Distance control On” switches distance control off.

	Off	On	Inactive	Description
Reference run	—			Pressing “Reference run on” starts a reference run.
Sensor in position	—			Pressing “Sensor in position” moves the sensor to the “programmed position”.

6 Start-up and configuration

6.1 Overview

Step	Description
1	Install and prepare the laser controller; in particular: prepare the laser program. (>>> 6.3 "Laser program" Page 22)
2	Configure the field bus between the robot controller and the laser controller in WorkVisual.
3	Configure the inputs and outputs to integrate the required peripheral equipment. ■ Laser and other peripheral welding equipment (standard LaserTech package) ■ Wire feed system (LaserWeld) ■ Sensor system (LaserCut) (>>> 6.2 "Variables for configuration of LaserTech" Page 21)
4	Calibrate the tool and base.
5	Configure gas types for inline forms. (>>> 6.4 "Configuring gas types for inline forms" Page 23)
6	Configure the inputs/outputs for gases and other properties. (>>> 6.5 "Configuring the inputs/outputs for gases and other properties" Page 24)
7	Configure the program number for the pilot laser. (>>> 6.6 "Configuring the pilot laser" Page 25)
8	If required: modify the maximum values for ramp times. (>>> 6.7 "Modifying maximum values for ramp times" Page 26)
9	If required: expand the technology for user-defined applications. (>>> 9.1 "Configuring user-defined applications" Page 67) (>>> 9.2 "Integration of user-defined functions" Page 68)

6.2 Variables for configuration of LaserTech

The variables for configuring LaserTech are described in the appendix.
Some of these variables, e.g. the process options, can be displayed and changed via the variable correction function.
To configure the inputs and outputs for interfacing with the peripheral equipment, the $CONFIG.DAT file in the directory R1\System must be edited.

Overview

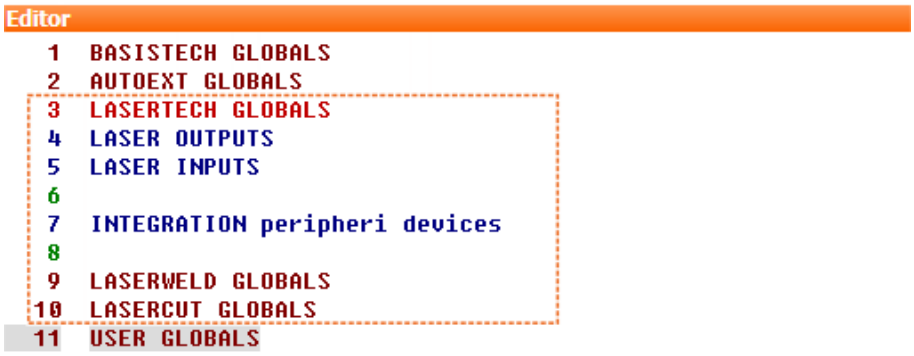

Fig. 6-1: Folds in $CONFIG.DAT

Line	Description
3 … 7	LASERTECH GLOBALS Here the inputs/outputs are configured which are used by the standard LaserTech package. ■ LASER OUTPUTS (>>> 11.1.2 "LaserTech: signal outputs to the laser" Page 82) ■ LASER INPUTS (>>> 11.1.3 "LaserTech: signal inputs from the laser" Page 83) ■ INTEGRATION peripheri devices (>>> 11.1.5 "LaserTech: signal inputs from the welding periphery" Page 85) ■ (>>> 11.1.4 "LaserTech: signal outputs to the welding periphery" Page 84)
9	LASERWELD GLOBALS Here the inputs/outputs are configured which are used by LaserWeld. ■ OUTPUTS WIREFEEDER (>>> 11.2.2 "LaserWeld: signal outputs to the wire feed system" Page 90) ■ WIRE CONTROL --> PLC (>>> 11.2.2 "LaserWeld: signal outputs to the wire feed system" Page 90) ■ INPUTS WIREFEEDER (>>> 11.2.3 "LaserWeld: signal inputs from the wire feed system" Page 91)
10	LASERCUT GLOBALS Here the inputs/outputs are configured which are used by LaserCut. (>>> 11.3.2 "LaserCut: signal outputs to the sensor" Page 93) (>>> 11.3.3 "LaserCut: signal inputs from the sensor" Page 94)

6.3 Laser program

On the laser controller there must be a laser program which can read in the parameters from an external controller (robot).

Fig. 6-2: Required laser program (example)

6.4 Configuring gas types for inline forms

Description

In the file C:\KRC\TP\LaserTech\LIB\LsrTech.XML, the user defines how many types of which gas are to be available in the inline forms. The names displayed in the inline forms for the gases can also be changed.

A maximum of 12 types of gas can be configured.

Precondition

- "Expert" user group
- Windows interface (smartHMI is minimized).

> Only the changes described in the procedure may be made in the file LsrTech.XML!

Procedure

1. Open the file C:\KRC\TP\LaserTech\LIB\LsrTech.XML.
2. Find the section for gases in the file.
   - Process gases: section `ProcessGas`
   - Root gases: section `RootGas`
   - Cutting gases: section `CutGas`
3. To change the name of a gas, modify a value of `EnumValue Key`.
4. To add a gas, copy a line that starts with `EnumValue Key` and paste it after the other lines. Renumber the values of `KrlValue="…"` and `OrderID="…"`.
5. Close the file by means of the **Close** icon and answer the request for confirmation with **Yes**. The file is saved.

Example

Excerpt from the `ProcessGas` section. The structure of the sections for the other gases is analogous.

```
...
<TechParam xsi:type="TechParamEnum" Name="ProcessGas" …
  <EnumValues Max="12">
  <EnumValue Key="Gas1" KrlValue="1" OrderID="0"
VisibleStyle="Allways"/>
  <EnumValue Key="Gas2" KrlValue="2" OrderID="1"
VisibleStyle="Allways"/>
  <EnumValue Key="Gas3" KrlValue="3" OrderID="2"
VisibleStyle="Allways"/>
  <EnumValue Key="Gas4" KrlValue="4" OrderID="3"
VisibleStyle="Allways"/>
  </EnumValues>
</TechParam>
...
```

6.5 Configuring the inputs/outputs for gases and other properties

Precondition

- "Expert" user group
- No program is selected.

Procedure

1. Open the desired file.
   - Process gases: R1\TP\LaserTech\laser.dat
     Open the `Process Gas Settings` fold.
   - Cutting gases: R1\TP\LASERCUT\lsc_main.dat
     Open the `Cut Gas Settings` fold.
   - Root gases: R1\TP\LaserTech\laser.dat
     Open the `Root Gas Settings` fold.
2. Edit the file.
3. Close the file by means of the **Close** icon and answer the request for confirmation with **Yes**. The file is saved.

Description

Excerpt from the `Process Gas Settings` fold in the file laser.dat. The excerpt shows the default properties defined. The structure of the folds in the other files is analogous.

```
LSR_ProcGAS[1]={OUT_NR 1024,IN_NR 1025,ANA_GAS_OUT TRUE,
ANA_GAS_IN TRUE,ExtIlf FALSE,ANA_MAX_VALUE 30.0,GAS_NAME[] "NONE"}
```

The configuration depends on whether a proportional gas valve is used.

Without valve

LSR_PropGasValve = FALSE

Element	Description
OUT_NR	Number of the digital output that is used to activate the gas
IN_NR	Number of the digital input that is used to indicate that the gas has been activated
ANA_GAS_OUT	Only FALSE meaningful. FALSE = this gas does not use a proportional gas valve.
ANA_GAS_IN	The currently measured gas pressure is returned to this analog channel.
ExtIlf	TRUE = advanced monitoring. Not only IN_NR is polled, but also the actual analog value of the gas pressure.
ANA_MAX_VALUE	Maximum gas pressure. This value is irrelevant.
GAS_NAME[]	Name of the gas (default: "NONE") Changing the name does not have any effect.

With valve LSR_PropGasValve = TRUE

Element	Description
OUT_NR	Number of the digital output that is used to activate the gas **Note**: The number of the analog channel is defined via the variable LSRI_GasPressure
IN_NR	Number of the digital input that is used to indicate that the gas pressure is OK **Note**: The number of the analog channel is defined via the variable LSRI_GasPressure
ANA_GAS_OUT	TRUE = this gas uses a proportional gas valve. FALSE = this gas does not use a proportional gas valve.
ANA_GAS_IN	The currently measured gas pressure is returned to this analog channel.
ExtIIf	TRUE = advanced monitoring. Not only IN_NR is polled, but also the actual analog value of the gas pressure.
ANA_MAX_VALUE	Maximum gas pressure transferred by the laser controller. If a higher value is set in the inline form, the lower value set here nonetheless applies. Unit: bar. Value must be greater than 0.0.
GAS_NAME[]	Name of the gas (default: “NONE”) Changing the name does not have any effect.

6.6 Configuring the pilot laser

Description In the file R1\TP\LaserTech\laser.dat, the program number is defined that is to be selected internally when the pilot laser is switched on using the status key. The program number must be present in the laser controller.

Precondition
- “Expert” user group
- No program is selected.

Procedure
1. Open the file R1\TP\LaserTech\laser.dat.
2. Open the `Temporary Process Setting` fold. In the following declaration, specify the desired program number for the element `LSR_PRG`.

```
DECL GLOBAL LSR_PWR_T LSR_LsrPilotSet={LSR_MAX_PWR 2000,
LSR_MIN_PWR 1,LSR_PRG 20,LSR_RAISE_TIME 1,LSR_DROP_TIME 1}
```

   In this example, laser program 20 is selected (LSR_PRG 20). In order to be able to use the pilot laser, there must be a program with the number 20 on the laser controller.

The correct fiber number must be entered in the laser program that is selected here. Otherwise it is possible that the pilot laser will not be visible.

3. Close the file by means of the **Close** icon and answer the request for confirmation with **Yes**. The file is saved.

6.7 Modifying maximum values for ramp times

Description

The ramp time when switching on (Laser power rise time) is programmed in the option window **Laser data** – **Activate process**.

(>>> 7.3.9 "Option window “Laser data” – Activate process/Step seam (via time)" Page 40)

The ramp time when switching off (Laser power drop time) is programmed in the option window **Laser data** – **Deactivate process**.

(>>> 7.3.12 "Option window “Laser data” – Deactivate process (via time)" Page 42)

The maximum values that can be set in the option windows can be modified in the registry.

Precondition

- “Expert” user group
- Windows interface (smartHMI is minimized).
- Administrator privileges on the Windows user interface

Procedure

1. In the Windows Start menu, select **Run…**.
2. In the **Open** box, enter “regedit” and press **OK**. The **Registry editor** window opens.
3. Select the following folder under “HKEY_CURRENT_USER\Software\VB and VBA Program Settings\KUKATPLASER\” in the tree structure:
   - LSR_DROP_TIME (for ramp time when switching off)
   - LSR_RAISE_TIME (for ramp time when switching on)
4. Click on the parameter **Max** and select **Change**.
5. Enter the desired value and confirm it by pressing **OK**.
6. Reboot the robot controller with a cold restart.

7 Programming for user group “User” (inline forms)

NOTICE Following creation of a laser program or modification of laser and motion commands, the program sequence, the actual switching points of the laser and the periphery must be checked. Damage to the system may otherwise result.

7.1 Programming with spline

Overview

The overview shows which LaserTech commands can be used in spline blocks.

Command	Usable in spline block?
Activate process	Yes
Switch process	Yes
Deactivate process	Yes
Step seam	Yes
Laser test pulse	No
Initialize laser	No
Enable laser	Yes
Laser off	No
Laser request	No
Switch gas	Yes
Initialize gas	No
Cut wire	No
Switch sensor	Yes
Sensor settings	Yes
Rectangle, **Slot**, **Hexagon**, **Circle**	No

7.2 Programming tips for KUKA.LaserTech

Power ramps

Power ramps can be defined over time or over distance. Which of the two functionalities is available depends on whether the laser is switched on and off inside or outside of a spline block.

- Laser is switched on/off within a spline block:
  Power ramps are defined via distance, e.g. the length of the power rise on switching on the laser.
- Laser is switched on/off outside a spline block:
  Power ramps are defined via time, e.g. the rise time of the laser power on switching on the laser.

Delay times

(>>> 7.2.1 "Defining delay times" Page 28)

Standstill monitoring

If the robot is stationary and the laser power is active, the shutter automatically closes after a defined time. This time is defined via the variable LSR_Stop_InspectionTime. The purpose is to prevent the laser from burning through the material.

If welding is to be carried out for longer at a specific position, i.e. without robot motion, the value of LSR_Stop_InspectionTime must be increased.

(>>> 11.1.8 "LaserTech: process constants" Page 88)

NOTICE If the value of LSR_Stop_InspectionTime is changed or if the option is deactivated, this can result in damage to the system.

If a laser pulse is generated using the instruction **Laser test pulse**, standstill monitoring is not active.

Switching points

- Program switching points in phases in which the velocity is as constant as possible.
- If a switching action is to be carried out before the taught point, the approximate positioning radius must be selected in such a way that the action is executed in the approximate positioning range of the point.

Circles

- To generate full circles, it is advisable not to teach the coordinates, but to calculate them.
- If the KUKA.ExpertTech technology package is available, use the specification **CA** for the circular angle.

7.2.1 Defining delay times

Description

The delay times are defined using the following variables:

- Delay time when switching on = LSR_ShutterDelayConst + LSR_ShutterOn
- Delay time when switching off = LSR_ShutterDelayConst + LSR_ShutterOff
- Delay time when switching over = LSR_ShutterDelayConst - LSR_ShutterOn

(>>> 11.1.8 "LaserTech: process constants" Page 88)

These variables are only used to compensate for delay times. They must not be used to offset switching points.

NOTICE If laser programs are already present and the delay times are changed, this can cause the activation and deactivation points of the laser to be shifted so far that damage to the device or other system components can result. Check existing programs following a modification.

Procedure

1. Program the weld seams.
2. Determine the required delay times empirically.
3. Change the following variables in the variable correction function, in accordance with the determined times:
   - LSR_ShutterDelayConst
   - LSR_ShutterOn
   - LSR_ShutterOff
4. For the other weld velocities, adapt the switching points by means of the Path specification in the inline forms.

Example 1

Required delay:

- When switching on: 80 ms
- When switching off: 50 ms
- When switching over: 20 ms

Define variables:

- LSR_ShutterDelayConst = 50

- LSR_ShutterOn = 30
- LSR_ShutterOff = 0

Example 2

Required delay:

- When switching on: 80 ms
- When switching off: 50 ms
- When switching over: 0 ms

If the delay when switching over is to be 0 ms, LSR_ShutterDelayConst and LSR_ShutterOn must always have the same value.

Define variables:

- LSR_ShutterDelayConst = 40
- LSR_ShutterOn = 40
- LSR_ShutterOff = 10

7.3 Programming laser functions

7.3.1 Inline form “Activate process”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Switching** > **Activate process**.

Description

This instruction switches the laser on.

> This instruction refers to the next motion instruction in the program. This motion instruction must be a CP motion.
> There must be no instructions triggering an advance run stop between the laser instruction and the motion instruction.

The CP motion to the laser activation position is generally approximated. In the case of exact positioning to the point, the laser is aimed at the point for longer than in the case of approximate positioning. This means that more energy is directed onto the point than is generally desirable.

If the CUT application is selected, the piercing and cutting data for laser cutting can optionally be defined.

If the piercing and cutting data are defined, the instruction calls a piercing function that implicitly activates the distance sensor. In this case, the instruction replaces the instruction **Switch sensor**.

(>>> 7.6.1 "Inline form “Switch sensor”" Page 52)

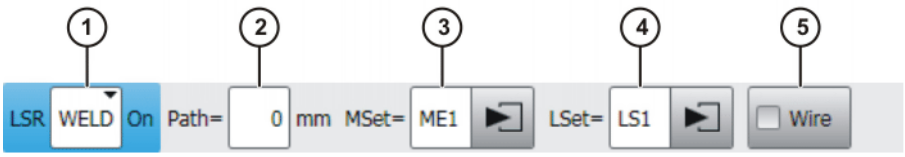

Fig. 7-1: Inline form “Activate process” (with Weld)

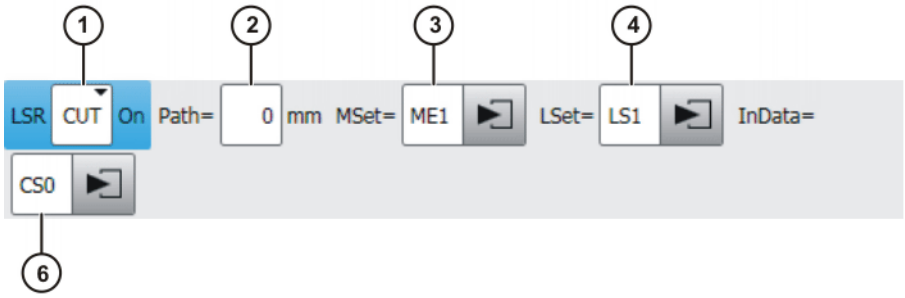

Fig. 7-2: Inline form “Activate process” (with Cut)

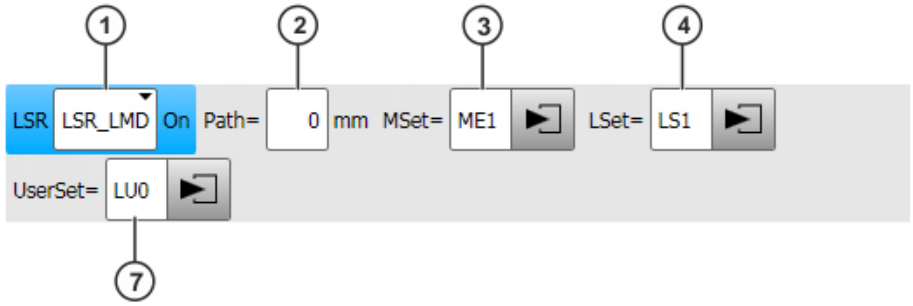

Fig. 7-3: Inline form “Activate process” (with UserSet)

Item	Description
1	Selects an application. ■ **[Empty box]**: Only displayed if LaserWeld is not installed. ■ **WELD**: Laser welding (with wire feed) ■ **CUT**: Laser cutting ■ **USR_LSR**, **USR_TCH**, **USR_LMB**: Up to 3 user-defined applications possible (default entries)
2	Shifts the activation point of the laser. ■ **-100 … 100 mm** **Note**: If the activation point is shifted to the wrong point, this can result in damage to the device or other system components.
3	Name for the media data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ For the applications **[Empty box]** and **WELD**: (>>> 7.3.6 "Option window “Media setting” – activating laser welding" Page 37) ■ For the application **CUT** and user-defined applications: (>>> 7.7.4 "Option window “Media data” – activating laser cutting" Page 59)
4	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ If the instruction is outside a spline block: (>>> 7.3.9 "Option window “Laser data” – Activate process/ Step seam (via time)" Page 40) ■ If the instruction is within a spline block: (>>> 7.3.10 "Option window “Laser data” – Activate process/ Step seam (via distance)" Page 41)

Item	Description
5	Only relevant for **WELD** application: Use of filler wire ■ **Check box active**: Use filler wire. ■ **Check box not active**: Do not use filler wire.
6	Only relevant for the **CUT** application: Name for the piercing and cutting data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.8 "Option window “Sensor parameters” and “Process parameters”" Page 61) This box can be displayed or hidden using the **Add Cut** and **Rem Cut** buttons.
7	Only relevant for user-defined applications: Name for the user-defined data set (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.14 "Option window – user-defined data set" Page 44)

If the gas is activated with the **Switch gas** instruction before the **Activate process** instruction and the setting “Continuous” is activated, the robot controller ignores the media data of the **Activate process** instruction (“Gas pressure” and “Gas preflow time”).
(>>> 7.5.1 "Inline form “Switch gas”" Page 50)
If there is no preceding **Switch gas** instruction with the setting “Continuous”, the gas is activated by the **Activate process** instruction.

7.3.2 Inline form “Switch process”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Switching** > **Switch process**.

Description

This instruction is used to modify the weld parameters within a weld path. The monitoring functions of the laser and weld media remain active following this instruction. If the application WELD is selected, the wire is fed further.

This instruction refers to the next motion instruction in the program. This motion instruction must be a CP motion.
There must be no instructions triggering an advance run stop between the laser instruction and the motion instruction.

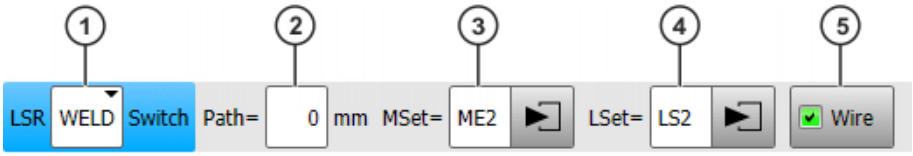

Fig. 7-4: Inline form “Switch process” (with Weld)

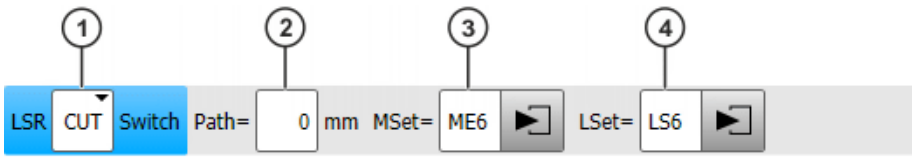

Fig. 7-5: Inline form “Switch process” (with Cut)

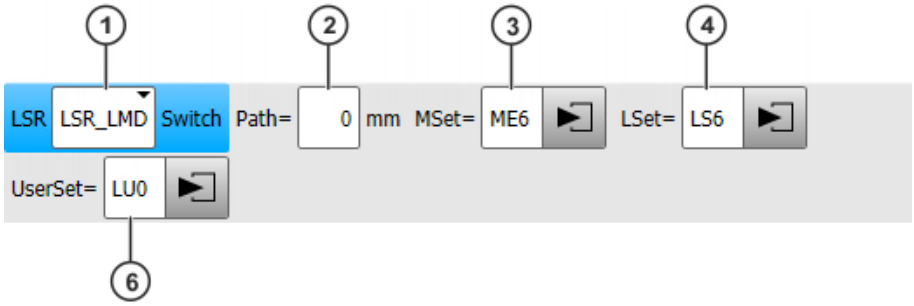

Fig. 7-6: Inline form “Switch process” (with UserSet)

Item	Description
1	Selects an application. ■ **[Empty box]**: Only displayed if LaserWeld is not installed. ■ **WELD**: Laser welding (with wire feed) ■ **CUT**: Laser cutting ■ **USR_LSR**, **USR_TCH**, **USR_LMB**: Up to 3 user-defined applications possible (default entries)
2	Shifts the switching point of the laser. ■ **-100 … 100 mm**
3	Name for the media data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ For the applications **[Empty box]** and **WELD**: (>>> 7.3.7 "Option window “Media setting” – switching laser welding" Page 38) ■ For the application **CUT** and user-defined applications: (>>> 7.7.5 "Option window “Media data” – switching laser cutting" Page 59) **Note**: This box is only displayed if velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE) or if filler wire is used for laser welding (**Wire** check box activated).
4	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.11 "Option window “Laser data” – Switch process" Page 42)

Item	Description
5	Only relevant for **WELD** application: Use of filler wire ■ **Check box active**: Use filler wire. ■ **Check box not active**: Do not use filler wire.
6	Only relevant for user-defined applications: Name for the user-defined data set (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.14 "Option window – user-defined data set" Page 44)

If the **Switch process** instruction is preceded by a **Switch gas** instruction with the setting “Continuous”, the robot controller ignores the parameters in the media set of the **Switch process** instruction (“Gas pressure” and “Gas preflow time”).
(>>> 7.5.1 "Inline form “Switch gas”" Page 50)

7.3.3 Inline form “Deactivate process”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Switching** > **Deactivate process**.

Description

This instruction switches off the laser power and terminates the laser program. The laser is not switched off.

If the gas has been activated earlier in the program with the **Switch gas** instruction and the setting “Continuous”, the robot controller ignores the media data of the **Deactivate process** instruction (“Gas pressure” and “Gas postflow time”).

The gas must be deactivated with the **Switch gas** instruction in such a case.

If there is no preceding **Switch gas** instruction with the setting “Continuous”, the gas is deactivated by the **Deactivate process** instruction.

This instruction refers to the next motion instruction in the program. This motion instruction must be a CP motion.
There must be no instructions triggering an advance run stop between the laser instruction and the motion instruction.

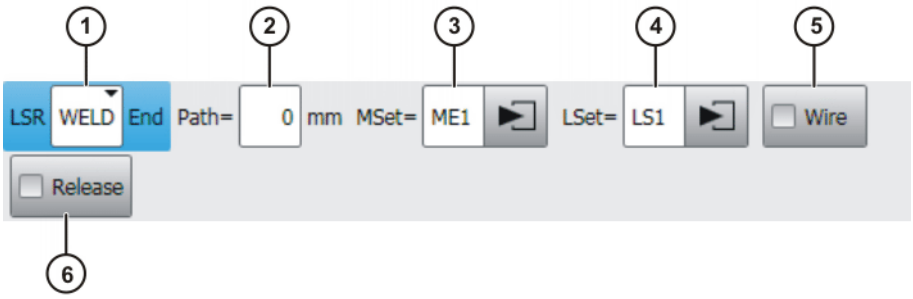

Fig. 7-7: Inline form “Deactivate process” (with Weld)

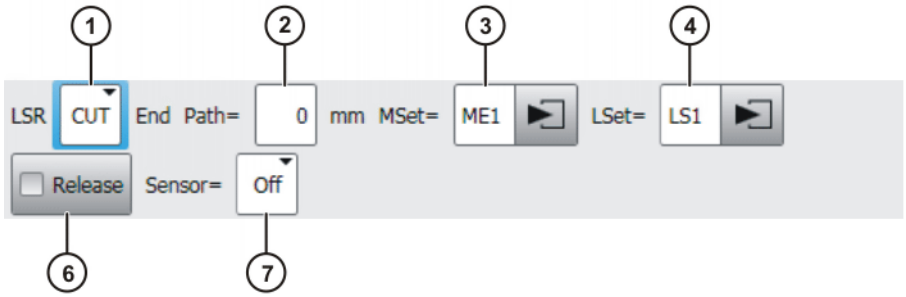

Fig. 7-8: Inline form “Deactivate process” (with Cut)

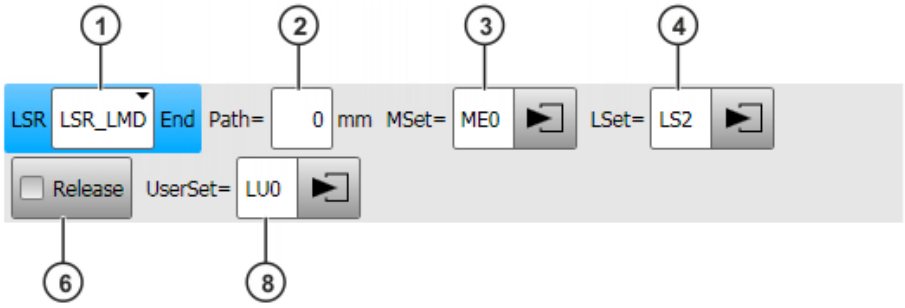

Fig. 7-9: Inline form “Deactivate process” (with UserSet)

Item	Description
1	Selects an application. ■ **[Empty box]**: Only displayed if LaserWeld is not installed. ■ **WELD**: Laser welding (with wire feed) ■ **CUT**: Laser cutting ■ **USR_LSR**, **USR_TCH**, **USR_LMB**: Up to 3 user-defined applications possible (default entries)
2	Shifts the end point. ■ **-100 … 100 mm**
3	Name for the media data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ For the applications **[Empty box]** and **WELD**: (>>> 7.3.8 "Option window “Media setting” – deactivating laser welding" Page 39) ■ For the application **CUT** and user-defined applications: (>>> 7.7.6 "Option window “Media data” – deactivating laser cutting" Page 60)
4	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ If the instruction is outside a spline block: (>>> 7.3.12 "Option window “Laser data” – Deactivate process (via time)" Page 42) ■ If the instruction is within a spline block: (>>> 7.3.13 "Option window “Laser data” – Deactivate process (via distance)" Page 43)

Item	Description
5	Only relevant for **WELD** application: Use of filler wire ■ **Check box active**: Use filler wire. ■ **Check box not active**: Do not use filler wire.
6	■ **Check box active**: The laser is enabled. ■ **Check box not active**: Not enabled.
7	Only relevant for the **CUT** application: Distance sensor ■ **Off**: Distance sensor OFF ■ **Hold**: The distance sensor remains in the current position. ■ **PrPos**: The distance sensor goes to the programmed position. This box can be displayed or hidden using the **Add Cut** and **Rem Cut** buttons.
8	Only relevant for user-defined applications: Name for the user-defined data set (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.14 "Option window – user-defined data set" Page 44)

7.3.4 Inline form “Step seam”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Switching** > **Step seam**.

Description

This instruction performs a step seam. The instruction cannot be used with laser welding or laser cutting.

This instruction refers to the next motion instruction in the program. This motion instruction must be a CP motion.
There must be no instructions triggering an advance run stop between the laser instruction and the motion instruction.

The step seam is canceled in the following cases:

- **Activate process** instruction
- **Deactivate process** instruction
- Exact positioning
- A smooth transition is made from a CP motion to a PTP motion.

Step seams are only possible without filler wire.

Step seams are velocity-dependent. If the velocity is modified, the seam must then be checked and optimized.

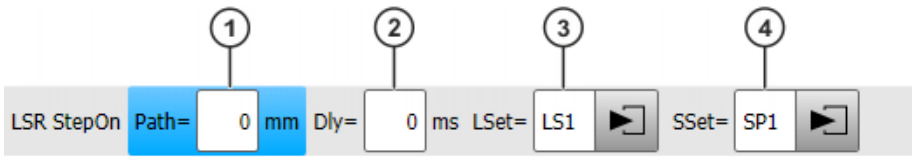

Fig. 7-10: Inline form “Step seam”

Item	Description
1	Shifts the activation point of the laser. ■ **-100 … 100 mm**
2	Execution of the instruction is brought forward in time or delayed. ■ **-100 … 100 ms**
3	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. ■ If the instruction is outside a spline block: (>>> 7.3.9 "Option window “Laser data” – Activate process/ Step seam (via time)" Page 40) ■ If the instruction is within a spline block: (>>> 7.3.10 "Option window “Laser data” – Activate process/ Step seam (via distance)" Page 41)
4	Name for the step parameters (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.15 "Option window “Step parameters”" Page 44)

7.3.5 Inline form “Laser test pulse”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Switching** > **Laser test pulse**.

Description

This instruction generates a laser pulse.

- The laser pulse can be measured to test the laser power. (Precondition: T1 mode.)
- The laser pulse can be executed several times to determine the focus of the optics. (Precondition: operating mode T1 or T2.)

NOTICE Not all monitoring functions are active with this instruction. Incorrect use can cause material damage. The instruction may only be used by trained personnel.

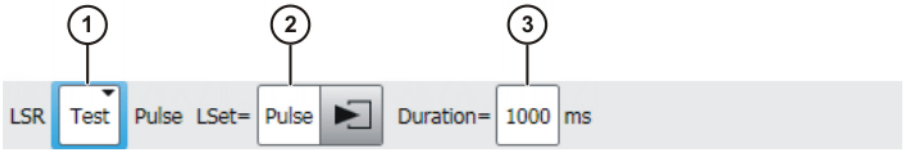

Fig. 7-11: Inline form “Laser test pulse”

Item	Description
1	Select function. ■ **Test**: Test the laser power. ■ **Focus**: Determine the focus of the optics.
2	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.16 "Option window “Laser data” – “Laser test pulse”" Page 45)
3	Duration of laser pulse ■ **12 … 20,000 ms**

7.3.6 Option window “Media setting” – activating laser welding

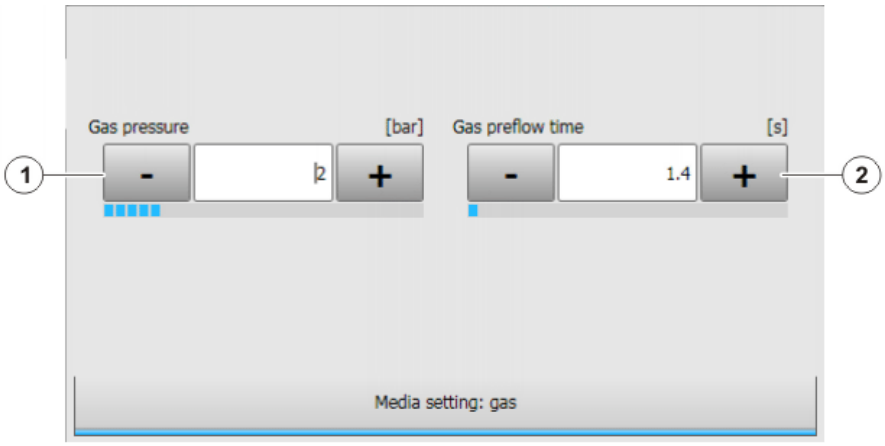

Fig. 7-12: Option window “Media setting: gas” – activating laser welding, without wire

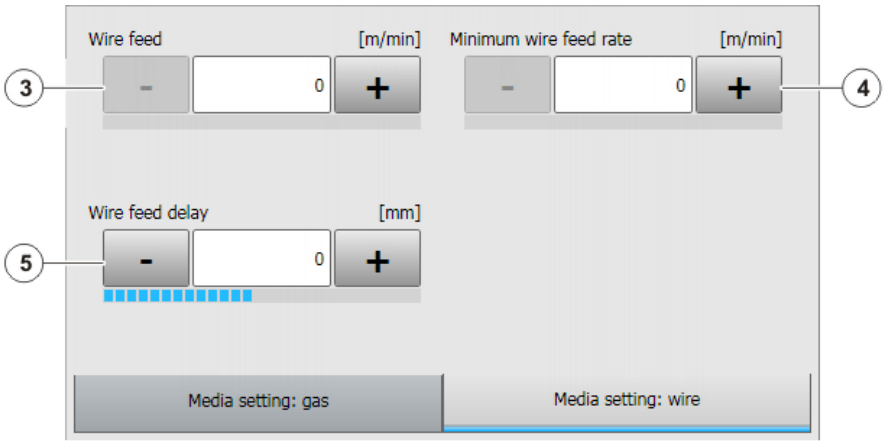

Fig. 7-13: Option window “Media setting: wire” – activating laser welding, with wire

Item	Description
1	Gas pressure ■ **0 … 10 bar** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).
2	Gas preflow time ■ **0 … 25 s**
3	Wirefeed ■ **0 … 25 m/min**
4	Minimum wire feed rate ■ **0 … 15 m/min**
5	Wirefeed delay ■ **-30 … 30 mm**

7.3.7 Option window “Media setting” – switching laser welding

The option window **Media setting: gas** is only available if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).

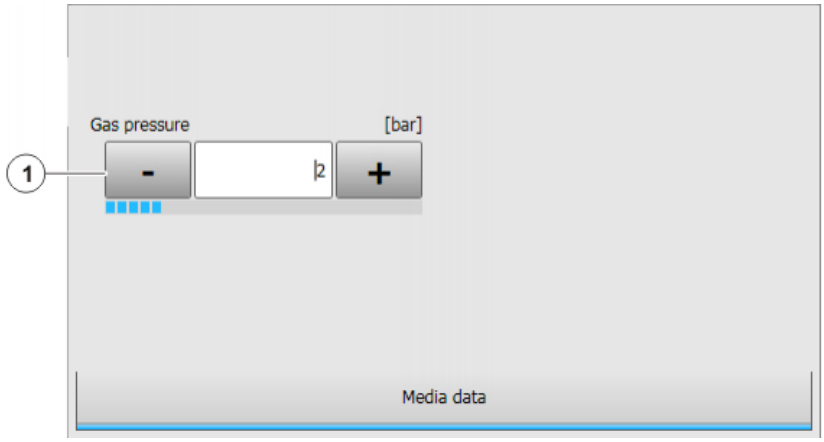

Fig. 7-14: Option window “Media setting: gas” – switching laser welding, without wire

The option window **Media setting: wire** is only available if filler wire is being used for laser welding (**Wire** check box in the inline form **Switch process** is activated).

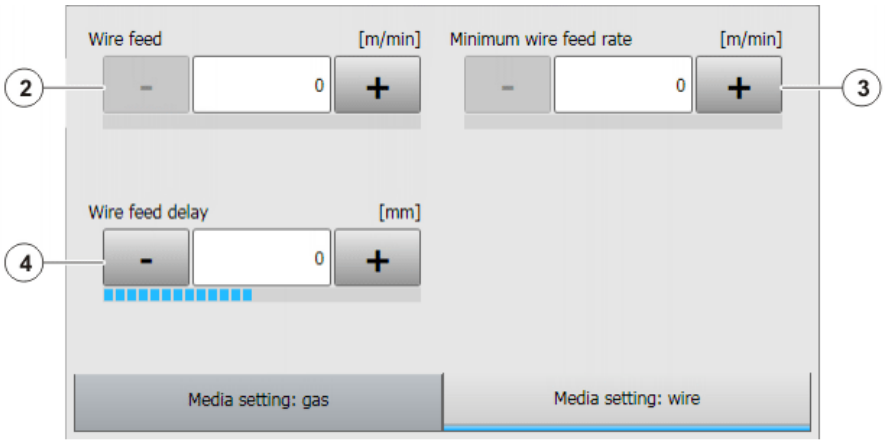

Fig. 7-15: Option window “Media setting: wire” – switching laser welding, with wire

Item	Description
1	Gas pressure ■ **0 … 10 bar**
2	Wirefeed ■ **0 … 25 m/min**
3	Minimum wire feed rate ■ **0 … 15 m/min**
4	Wirefeed delay ■ **-30 … 30 mm**

7.3.8 Option window “Media setting” – deactivating laser welding

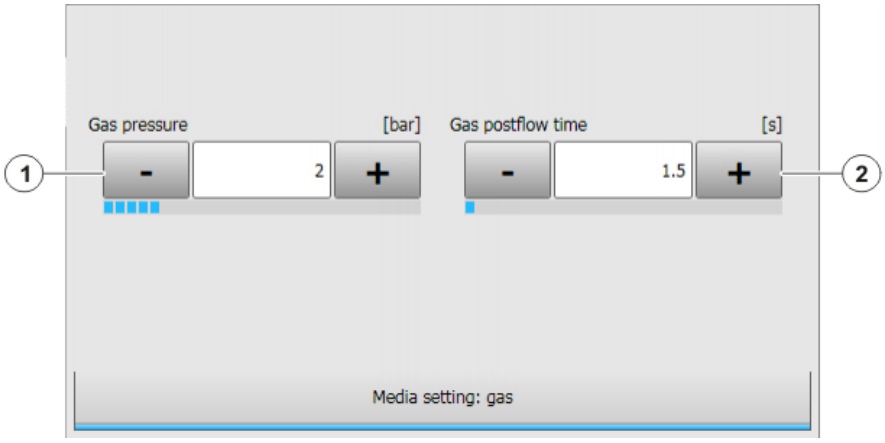

Fig. 7-16: Option window “Media setting: gas” – deactivating laser welding, without wire

The option window **Media setting: wire** is only available if filler wire is being used for laser welding (**Wire** check box in the inline form **Deactivate process** is activated).

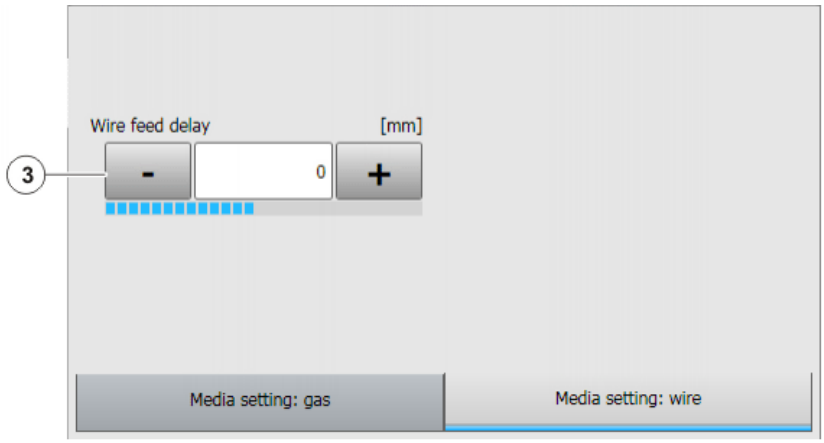

Fig. 7-17: Option window “Media setting: wire” – deactivating laser welding, with wire

Item	Description
1	Gas pressure ■ **0 … 10 bar** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).
2	Gas postflow time ■ **0 … 25 s**
3	Wirefeed delay ■ **-30 … 30 mm**

7.3.9 Option window “Laser data” – Activate process/Step seam (via time)

This option window is called via the inline forms **Activate process** and **Step seam**, if these are outside a spline block. In the case, the power ramp is defined via time.

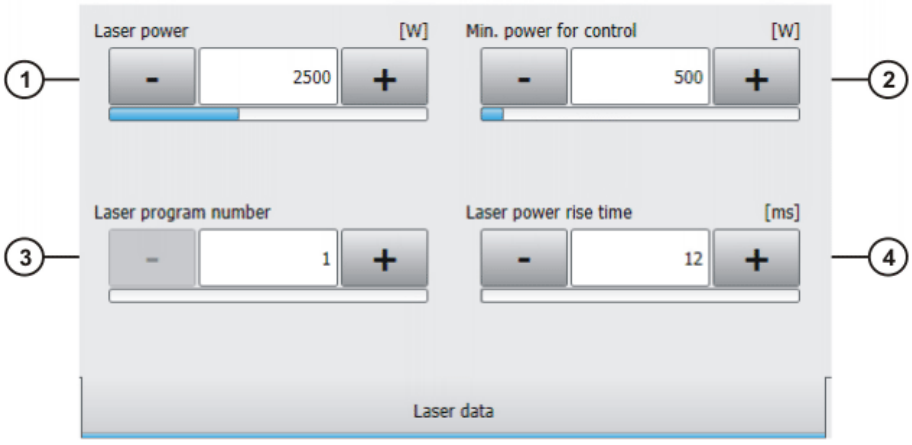

Fig. 7-18: Option window “Laser data” – Activate process (via time)

Item	Description
1	Laser power at 100% velocity (maximum power) ■ **60 … 6,000 W**
2	Minimum power for velocity-dependent control of the laser power ■ **60 … 6,000 W** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).
3	Laser program number ■ **1 … 200**
4	Laser power rise time Time that elapses after activation before the laser reaches full power ■ **1 … 2,000 ms** The maximum laser power rise time can be modified in the registry. (>>> 6.7 "Modifying maximum values for ramp times" Page 26)

7.3.10 Option window “Laser data” – Activate process/Step seam (via distance)

This option window is called via the inline forms **Activate process** and **Step seam**, if these are within a spline block. In the case, the power ramp is defined via distance.

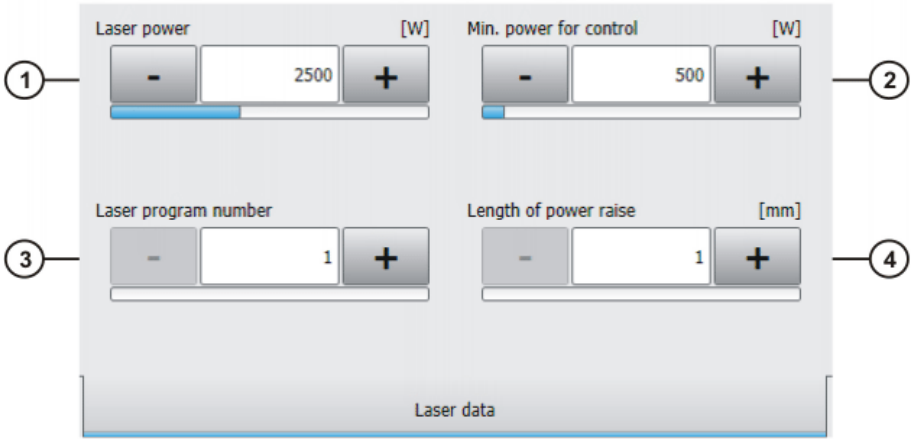

Fig. 7-19: Option window “Laser data” – Activate process (via distance)

Item	Description
1	Laser power at 100% velocity (maximum power) ■ **60 … 6,000 W**
2	Minimum power for velocity-dependent control of the laser power ■ **60 … 6,000 W** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).

Item	Description
3	Laser program number ■ **1 … 200**
4	Length of power rise Distance traveled after activation before the laser reaches full power ■ **1 … 2,000 mm**

7.3.11 Option window “Laser data” – Switch process

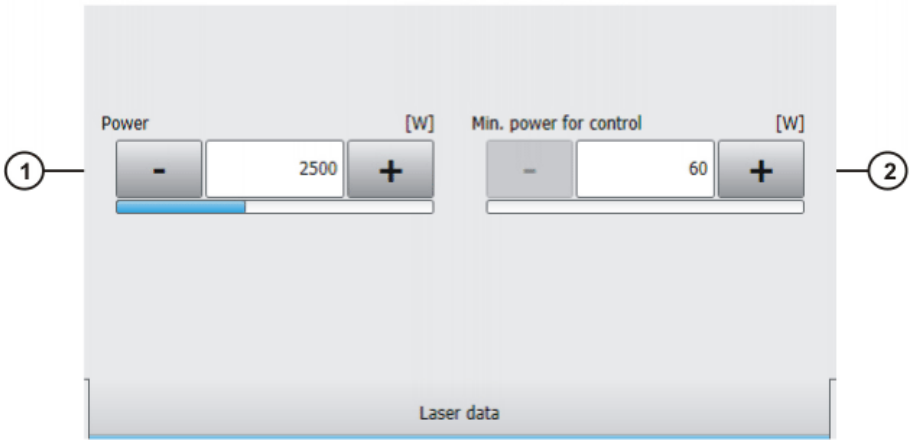

Fig. 7-20: Option window “Laser data” – Switch process

Item	Description
1	Laser power at 100% velocity ■ **60 … 6,000 W**
2	Minimum power for velocity-dependent control of the laser power ■ **60 … 6,000 W** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).

7.3.12 Option window “Laser data” – Deactivate process (via time)

This option window is called via the inline form **Deactivate process**, if this is outside a spline block. In the case, the power ramp is defined via time.

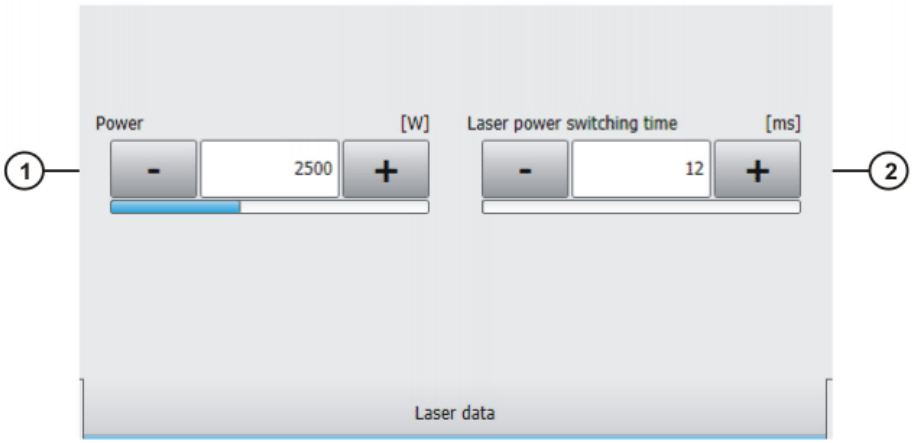

Fig. 7-21: Option window “Laser data” – Deactivate process (via time)

Item	Description
1	Power limit during deactivation ■ **60 … 6,000 W**
2	Laser power drop time Time taken after deactivation for the laser to decrease its power ■ **1 … 2,000 ms** The maximum laser power drop time can be modified in the registry. (>>> 6.7 "Modifying maximum values for ramp times" Page 26)

7.3.13 Option window “Laser data” – Deactivate process (via distance)

This option window is called via the inline form **Deactivate process**, if this is within a spline block. In the case, the power ramp is defined via distance.

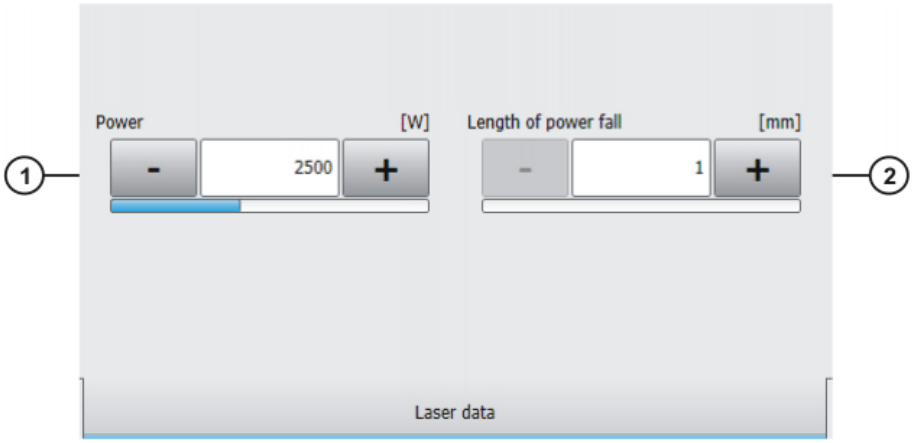

Fig. 7-22: Option window “Laser data” – Deactivate process (via distance)

Item	Description
1	Power limit during deactivation ■ **60 … 6,000 W**
2	Length of power fall Distance traveled after deactivation until the laser power is ramped down ■ **1 … 2,000 mm**

7.3.14 Option window – user-defined data set

Up to 12 user-defined parameters can be set in this option window.

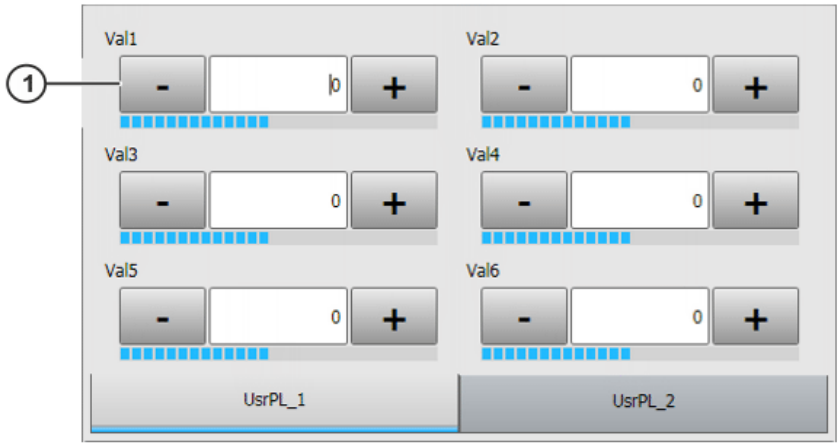

Fig. 7-23: Option window – user-defined data set

Item	Description
1	Parameter value which can be used for additional user-specific functions The name of the parameter and the unit are defined by the user. (>>> 9.1.2 "Changing parameter names and units in the option window" Page 68)

7.3.15 Option window “Step parameters”

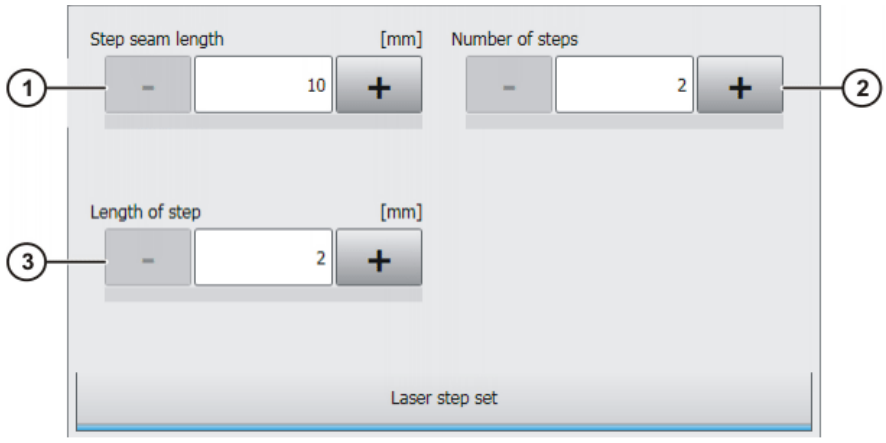

Fig. 7-24: Option window: Step parameters

Item	Description
1	Length of the step seam ■ **10 … 10,000 mm**
2	Number of steps ■ **2 … 500**
3	Length of a step ■ **2 … 50 mm**

7.3.16 Option window “Laser data” – “Laser test pulse”

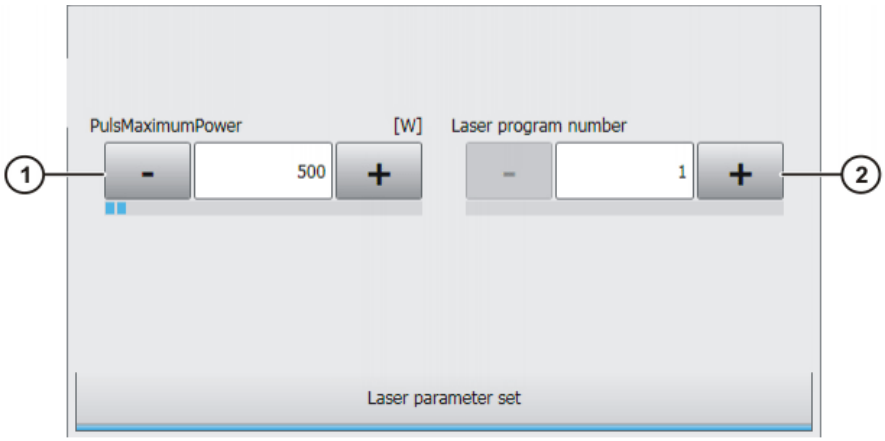

Fig. 7-25: Option window “Laser data” – “Laser test pulse”

Item	Description
1	Laser power for the laser pulse ■ **60 … 6,000 W**
2	Laser program number ■ **1 … 200**

7.4 Programming laser control

7.4.1 Inline form “Initialize laser”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Control commands** > **Initialize laser**.

Description

This instruction initializes the laser. The first laser instruction in the KRL program must always be **Initialize laser**.

This instruction triggers an advance run stop.

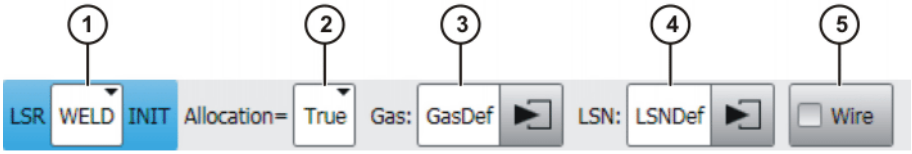

Fig. 7-26: Inline form “Initialize laser”

Item	Description
1	Selects an application. ■ **[Empty box]**: Only displayed if LaserWeld is not installed. ■ **WELD**: Laser welding (with wire feed) ■ **CUT**: Laser cutting ■ **USR_LSR**, **USR_TCH**, **USR_LMB**: Up to 3 user-defined applications possible (default entries)
2	Defines whether the laser is to be allocated to the robot during initialization. Only relevant if the robot belongs to a laser network. ■ **True**: Laser is allocated to the robot during initialization. ■ **False**: Laser is not allocated to a robot during initialization.
3	Name for the defined gas types (name freely definable) Touch the arrow to select the gas type. The corresponding option window is opened. ■ For the application **WELD**: (>>> 7.4.5 "Option window “Gas selection” – laser welding" Page 48) ■ For the application **CUT**: (>>> 7.4.6 "Option window “Gas selection” – laser cutting" Page 49)
4	Name for the defined lasers (name freely definable) Touch the arrow to select the laser. The corresponding option window is opened. (>>> 7.4.7 "Option window “Laser network” – “Initialize laser”" Page 49)
5	Only relevant for **WELD** application: Use of filler wire ■ **Check box active**: Use filler wire. ■ **Check box not active**: Do not use filler wire.
6	Only relevant for user-defined applications: Name for the user-defined data set (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.3.14 "Option window – user-defined data set" Page 44)

7.4.2 Inline form “Enable laser”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Control commands** > **Enable laser**.

Description

This instruction can be used to enable the laser for use by other robots at the end of a path. It is only relevant if the robot belongs to a laser network.

The instruction has the following effects:

- The gas supply is shut off.
- The laser is enabled.

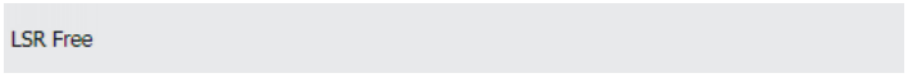

Fig. 7-27: Inline form “Enable laser”

7.4.3 Inline form “Laser off”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Control commands** > **Laser off**.

Description

This instruction has the following effects:

- The laser is deactivated.
- The gas supply is shut off.
- The laser is enabled.

NOTICE This instruction should only be used if the laser is to be deactivated for a prolonged period.

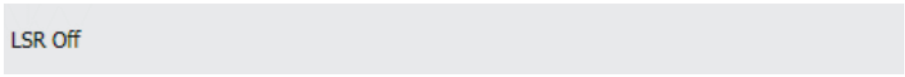

Fig. 7-28: Inline form “Laser off”

7.4.4 Inline form “Laser request”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Control commands** > **Laser request**.

Description

This instruction requests the laser via the signal LSRO_LsrRequest.

It is possible to program the robot controller to wait for the laser if the laser is allocated. To do so, use the instruction with **Allocate** (check box is activated).

The switching point for the instruction should be far enough before the next activation point to enable the robot to brake before the start of the seam to wait for allocation of the laser. Following allocation, the robot must be able to accelerate in order to reach the programmed velocity at the start of the seam. This is possible with the parameters **Path** and **Delay**.

This instruction refers to the next motion instruction in the program. This motion instruction must be a CP motion.
There must be no instructions triggering an advance run stop between the laser instruction and the motion instruction.

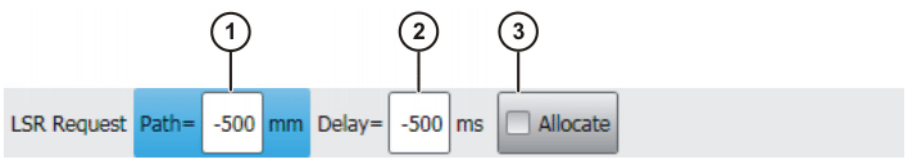

Fig. 7-29: Inline form “Laser request”

Item	Description
1	The point at which the instruction is executed is shifted forwards or backwards. ■ **-2,000 … 1,000 mm**
2	Execution of the instruction is brought forward in time or delayed. ■ **-2,000 … 1,000 ms**
3	Laser Allocate ■ **Check box active**: The robot controller accesses the laser if it is not allocated. If the laser is allocated, the robot stops. The robot controller waits for the laser to be assigned to it. ■ **Check box not active:** If the laser is allocated, the robot controller does not wait until the laser is assigned to it.

7.4.5 Option window “Gas selection” – laser welding

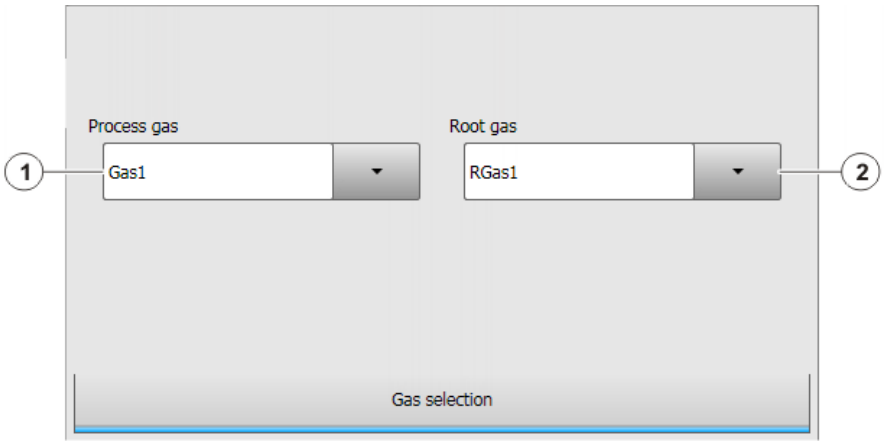

Fig. 7-30: Option window “Gas selection” – laser welding

Item	Description
1	Select process gas. The range of values depends on how many gas types have been configured. (>>> 6.4 "Configuring gas types for inline forms" Page 23)
2	Select root gas. The range of values depends on how many gas types have been configured. (>>> 6.4 "Configuring gas types for inline forms" Page 23)

7.4.6 Option window “Gas selection” – laser cutting

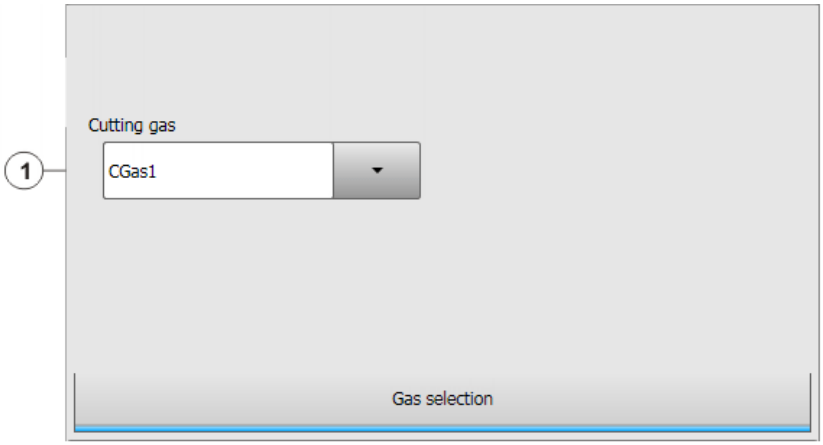

Fig. 7-31: Option window “Gas selection” – laser cutting

Item	Description
1	Select cutting gas. The range of values depends on how many gas types have been configured. (>>> 6.4 "Configuring gas types for inline forms" Page 23)

7.4.7 Option window “Laser network” – “Initialize laser”

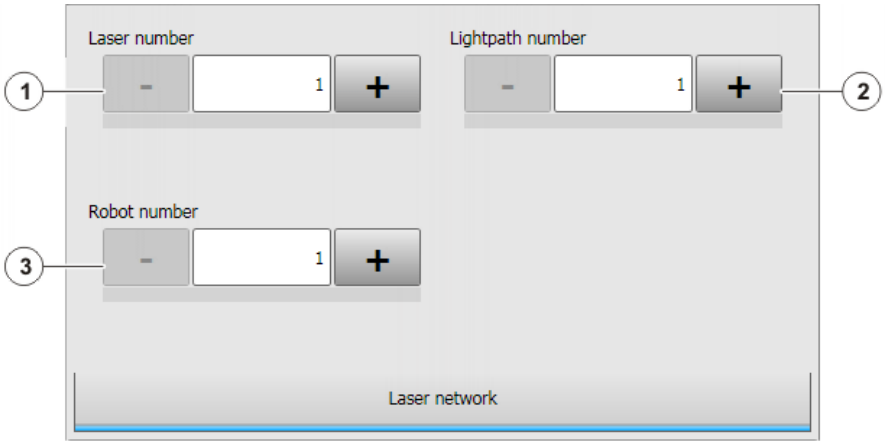

Fig. 7-32: Option window “Laser network” – “Initialize laser”

Item	Description
1	Select laser number. ■ **1 … 15**
2	Select the fiber number. ■ **1 … 8**
3	Select robot number. ■ **1 … 6**

7.5 Programming media control

7.5.1 Inline form “Switch gas”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Media control** > **Switch gas**.

Description

This instruction switches the gas on or off.

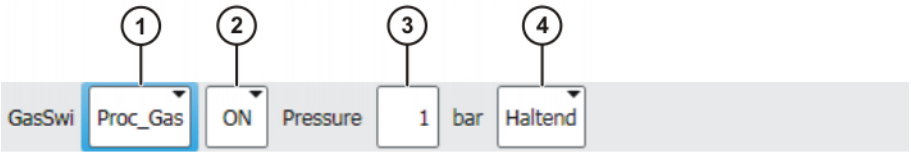

Fig. 7-33: Inline form “Switch gas”

Item	Description
1	Selects a gas. ■ **Proc_Gas**: process gas ■ **Root_Gas**: root gas ■ **Cut_Gas**: cutting gas ■ **CrossJet** ■ **All**: all gases **Note**: It is not possible to activate all gases simultaneously. **All** can only be used to deactivate the gases simultaneously.
2	Switches the selected gas on or off. ■ **ON**: Switches the gas on. ■ **OFF**: Switches the gas off. **Note**: The gas is only switched off if the laser is not active.
3	Gas pressure ■ **0 … 20 bar** This box is only displayed if a proportional gas valve is used (LSR_PropGasValve = TRUE).
4	Only relevant for **ON**: ■ **Continuous**: The instruction applies until the next **Switch gas** instruction is programmed. Until then, the gas parameters (gas pressure, gas preflow time, gas postflow time) for the **Activate process**, **Switch process** and **Deactivate process** instructions are ignored. ■ **Once**: The gas parameters for the subsequent **Activate process**, **Switch process** and **Deactivate process** instructions in the program apply until a new gas is activated with the instruction **Switch gas**.

7.5.2 Inline form “Initialize gas”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Media control** > **Initialize gas**.

Description

This instruction is used to select the gases required for the process. The instruction must be used at least once in an application program. It must be placed before the **Initialize laser** instruction and before the first **Activate process** instruction.

Within a program, the instruction is used to change the type of gas. If there is a process gas active when the instruction is executed, the process gas is deactivated. The **Switch gas** instruction is then required to activate the gas.

If the **Initialize gas** instruction is not used in a KRL program, the gas is automatically initialized with the **Initialize laser** instruction.

Fig. 7-34: Inline form “Initialize gas”

Item	Description
1	Selects an application. ■ **[Empty box]**: Only displayed if LaserWeld is not installed. ■ **WELD**: Laser welding (with wire feed) ■ **CUT**: Laser cutting
2	Name for the defined gas types (name freely definable) Touch the arrow to select the gas type. The corresponding option window is opened. ■ For the application **WELD**: (>>> 7.4.5 "Option window “Gas selection” – laser welding" Page 48) ■ For the application **CUT**: (>>> 7.4.6 "Option window “Gas selection” – laser cutting" Page 49)

7.5.3 Inline form “Cut wire”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Media control** > **Cut wire**.

Description

To cut the welding wire to length reliably using a cutting device, the wire can be advanced a certain distance using this instruction. (Check box **Cut** is not active.)

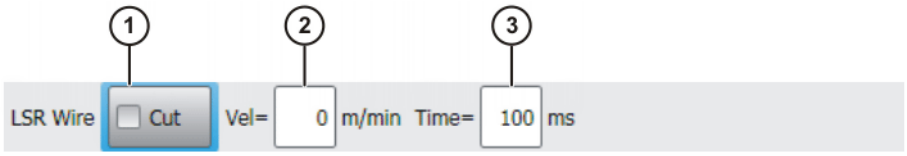

Fig. 7-35: Inline form “Cut wire” (without Cut)

This instruction is used to cut the wire with the laser. (Check box **Cut** is active.)

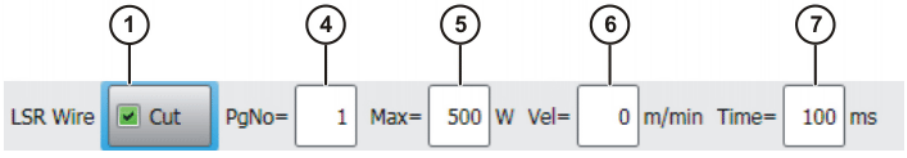

Fig. 7-36: Inline form “Cut wire” (with Cut)

Item	Description
1	Wire cutting with laser pulse ■ **Check box active**: Wire is cut with laser pulse. ■ **Check box not active:** Wire is not cut with laser pulse.
2	Velocity of the wire feed ■ **0 … 25 m/min**
3	Duration of the wire feed ■ **100 … 3,000 ms**
4	Laser program number ■ **1 … 200** This box is only displayed if the check box **Cut** is activated.
5	Laser power for cutting the wire ■ **60 … 60,000 W** This box is only displayed if the check box **Cut** is activated.
6	Wire feed rate ■ **0 … 25 m/min**
7	Pulse duration for cutting the wire ■ **100 … 3,000 ms**

7.6 Programming sensor control

7.6.1 Inline form “Switch sensor”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Sensor control** > **Switch sensor**.

Description

This command is used to define the settings for the distance sensor.

The cutting distance defined here can be transferred as an analog value or via a program number. This is set using the variable LSC_AnaCutDistance.

- TRUE = cutting distance is transferred as an analog value.
- FALSE = cutting distance is transferred via a program number (default).

Procedure for InDLY > 0:

1. Tip compensation time 2 is taken into consideration.
2. Motion stop
3. The robot moves to the point specified by the value defined in LSC_SecDistance.
4. The wait time defined in InDLY expires.
5. The cutting gas is switched. The distance defined in the inline form is set.
6. The wait time defined in LSC_SecInDly expires.
7. The motion is resumed.

This instruction is also used to modify an existing cutting distance. In this case, LsrCutSensor = On, InDLY = 0 and the new distance are programmed.

Detailed information about the distance sensor and distance controller is contained in the PRECITEC documentation.

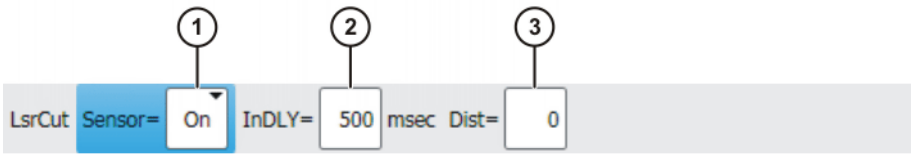

Fig. 7-37: Inline form “Switch sensor” (analog distance)

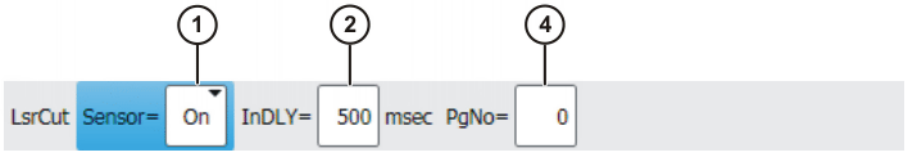

Fig. 7-38: Inline form “Switch sensor” (program-controlled distance)

Item	Description
1	Distance sensor ■ **On**: Distance sensor ON ■ **Off**: Distance sensor OFF ■ **Hold**: The distance sensor remains in the current position. ■ **PrPos**: The distance sensor goes to the programmed position.
2	Piercing position after the end point of the motion. ■ **0 ... 4,000 ms**
3	Cutting distance; unit: 1/10 mm ■ **1 … 300** This box is only displayed if the cutting distance is transferred as an analog value (LSC_AnaCutDistance = TRUE).
4	Number of the program in the sensor controller that regulates the cutting distance ■ **1 … 3** This box is only displayed if the cutting distance is transferred via a program number (LSC_AnaCutDistance = TRUE).

7.6.2 Inline form “Sensor settings”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Sensor control** > **Sensor settings**.

Description

This instruction can be used to set the cutting and piercing data for laser cutting and call a piercing function. This piercing function implicitly switches the distance sensor on.

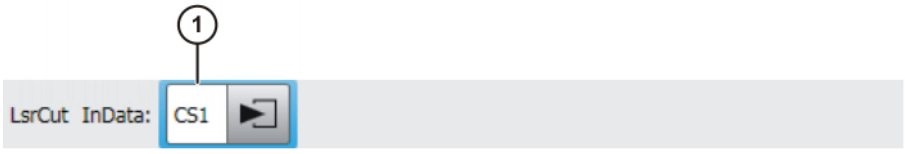

Fig. 7-39: Inline form “Sensor settings”

Item	Description
1	Name for the piercing and cutting data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.8 "Option window “Sensor parameters” and “Process parameters”" Page 61)

7.7 Programming laser cutting

7.7.1 Inline form “Rectangle”, “Slot”, “Hexagon”, “Circle”

Call

- Select the menu sequence **Commands** > **LaserTech** > **Cutting**.

  The following menu items are available:

  - **Rectangle**
  - **Slot**
  - **Hexagon**
  - **Circle**

Description

This command defines which pattern will be cut. Optionally, the cutting and piercing data for laser cutting can be defined.

If the piercing and cutting data are defined, the instruction calls a piercing function that implicitly activates the distance sensor. In this case, the instruction replaces the instruction **Switch sensor**.

(>>> 7.6.1 "Inline form “Switch sensor”" Page 52)

Every cutting pattern is executed as a spline motion.

NOTICE These instructions execute a calculated motion based on the parameters set in the option window. Incorrectly set parameters can result in damage to the system. Always carry out a test tun after creating or modifying these instructions.

To cut lines, a LIN motion command is used.

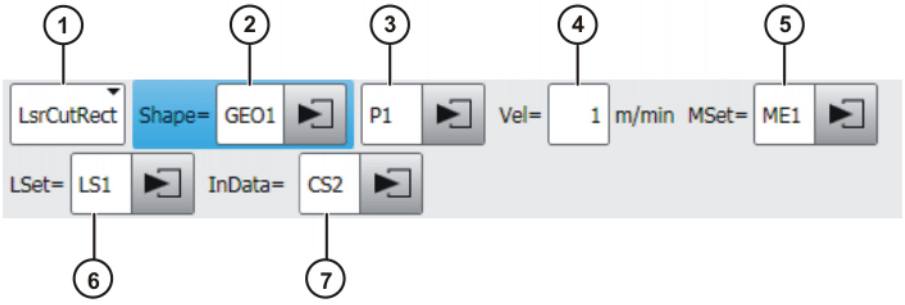

Fig. 7-40: Inline form “Rectangle”

Item	Description
1	Selects a pattern. ■ **LsrCutRect**: Rectangle ■ **LsrCutSlot**: Slot ■ **LsrCutHex**: Hexagon ■ **LsrCutCircle**: Circle
2	Name for the geometry data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.2 "Option windows “Geometry data” and “Geo motion data”" Page 55)
3	Name of the end point (name freely definable) Touch the arrow to edit the point data. The corresponding option window is opened. (>>> 7.7.3 "Option window: Frames" Page 58)
4	Velocity ■ **0.01 … 10 m/min**
5	Name for the media data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.4 "Option window “Media data” – activating laser cutting" Page 59)
6	Name for the laser data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.7 "Option window “Laser data” – Rectangle, Slot, Hexagon, Circle" Page 60)
7	Name for the piercing and cutting data (name freely definable) Touch the arrow to edit the data. The corresponding option window is opened. (>>> 7.7.8 "Option window “Sensor parameters” and “Process parameters”" Page 61) This box can be displayed or hidden using the **Add Cut** and **Rem Cut** buttons.

7.7.2 Option windows “Geometry data” and “Geo motion data”

Description

This option window is called from the following inline forms:

- **Rectangle**
- **Slot**
- **Hexagon**
- **Circle**

The meaning of the boxes depends on the pattern selected in the inline form.

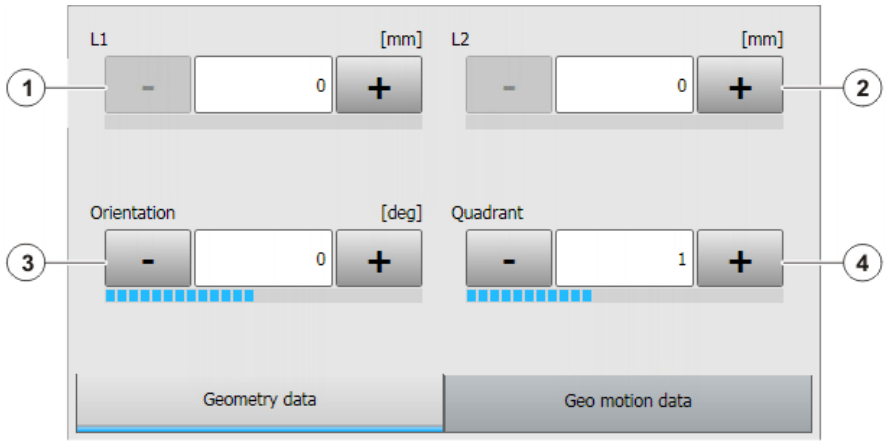

Fig. 7-41: Option window “Geometry data”

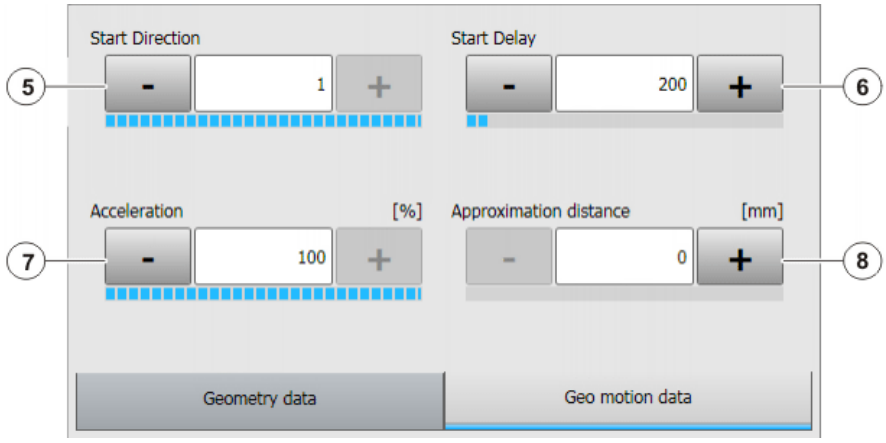

Fig. 7-42: Option window “Geo motion data”

Rectangle

Item	Description
1	Side length of 1st cut ■ Positive values
2	Side length of 2nd cut ■ Positive values
3	Orientation angle of the rectangle in the XY plane relative to the current base system ■ **0° … 360°**
4	Area within the rectangle where initial piercing takes place ■ **1 … 4**
5	Initial cutting direction ■ **-1**: to the left ■ **1**: to the right
6	Interval between laser switch-on and start of robot motion ■ **0 … 3000 ms**
7	Acceleration Refers to the maximum value specified in the machine data. The maximum value depends on the robot type and the selected operating mode.
8	Approximation distance

Slot

Item	Description
1	Length of the long side The value must be greater than the length of the short side.
2	Length of the short side The value must be less than the length of the long side.
3	Orientation angle of the slot in the XY plane relative to the current base system ■ **0° … 360°**
4	Area within the slot where initial piercing takes place ■ **1 … 4**
5	— — —
6	Interval between laser switch-on and start of robot motion ■ **0 … 3000 ms**
7	Acceleration Refers to the maximum value specified in the machine data. The maximum value depends on the robot type and the selected operating mode.
8	Approximation distance

Hexagon

Item	Description
1	Side length of hexagon ■ Positive values
2	— — —
3	Orientation angle of the hexagon in the XY plane relative to the current base system ■ **0° … 360°**
4	Area within the hexagon where initial piercing takes place ■ **1 … 4**
5	Initial cutting direction ■ **-1**: to the left ■ **1**: to the right
6	Interval between laser switch-on and start of robot motion ■ **0 … 3000 ms**
7	Acceleration Refers to the maximum value specified in the machine data. The maximum value depends on the robot type and the selected operating mode.
8	Approximation distance

Circle

Item	Description
1	Diameter of the circle ■ Positive values
2	Angle, if only an arc is being cut ■ Positive values
3	— — —
4	Area within the circle where initial piercing takes place ■ **1 … 4**

Item	Description
5	Initial cutting direction ■ **-1**: to the left If an arc is cut , "-1" must be entered. ■ **1**: to the right
6	Interval between laser switch-on and start of robot motion ■ **0 … 3000 ms**
7	Acceleration Refers to the maximum value specified in the machine data. The maximum value depends on the robot type and the selected operating mode.
8	Approximation distance

7.7.3 Option window: Frames

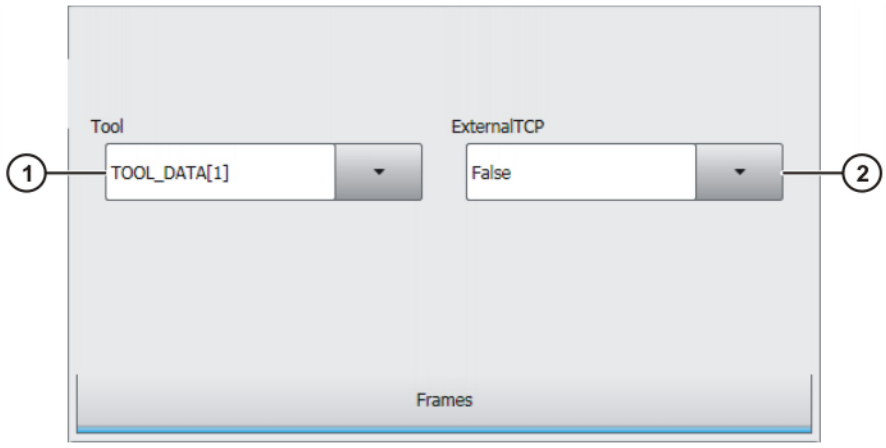

Fig. 7-43: Option window: Frames

Item	Description
1	Tool selection. ■ **[1] … [16]** If **True** in the box **ExternalTCP**: workpiece selection.
2	Interpolation mode ■ **False**: The tool is mounted on the mounting flange. ■ **True**: The tool is a fixed tool.

7.7.4 Option window “Media data” – activating laser cutting

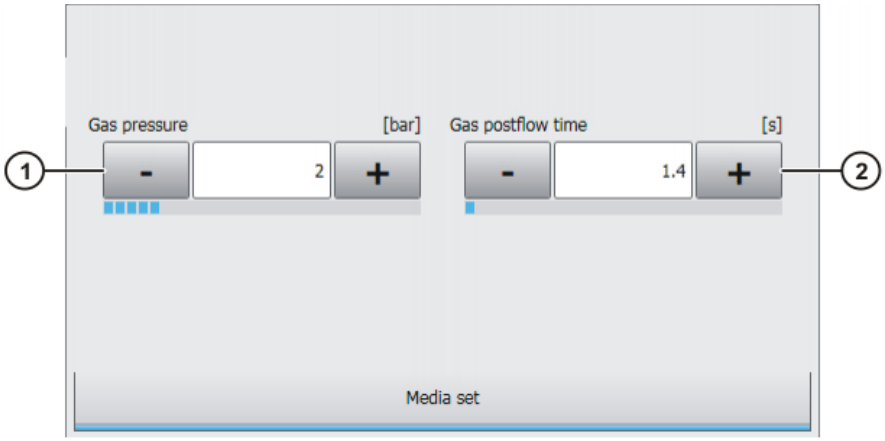

Fig. 7-44: Option window “Media data” – activating laser cutting

Item	Description
1	Gas pressure ■ **0 … 10 bar** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).
2	Gas preflow time ■ **0 … 25 s**

If the gas preflow time overlaps with the gas postflow time of the previous motion, the gas continues to flow without interruption.

7.7.5 Option window “Media data” – switching laser cutting

This option window is only available if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).

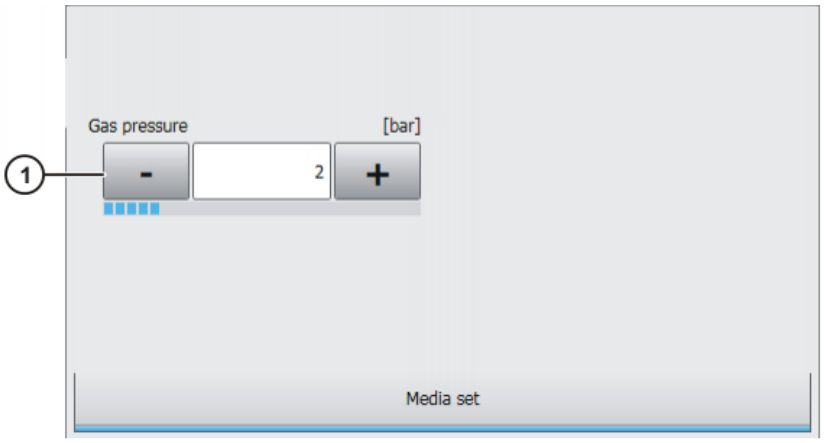

Fig. 7-45: Option window “Media data” – switching laser cutting

Item	Description
1	Gas pressure ■ **0 … 10 bar**

7.7.6 Option window “Media data” – deactivating laser cutting

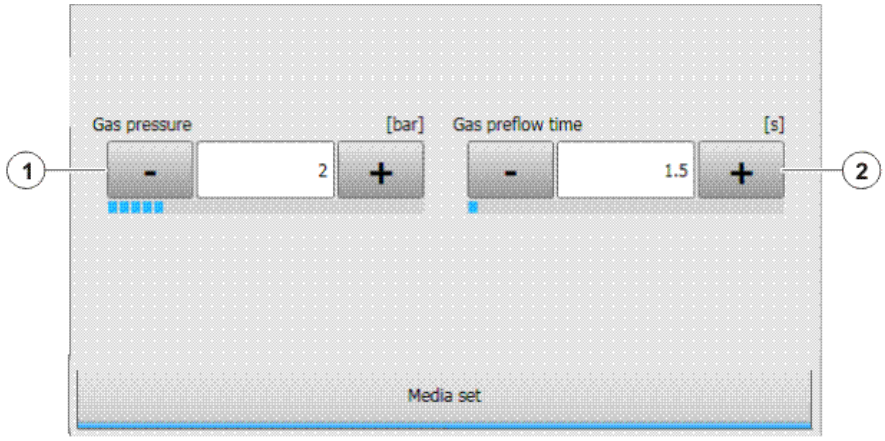

Fig. 7-46: Option window “Media data” – deactivating laser cutting

Item	Description
1	Gas pressure ■ **0 … 10 bar** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).
2	Gas postflow time ■ **0 … 25 s**

If the gas preflow time overlaps with the gas postflow time of the previous motion, the gas continues to flow without interruption.

7.7.7 Option window “Laser data” – Rectangle, Slot, Hexagon, Circle

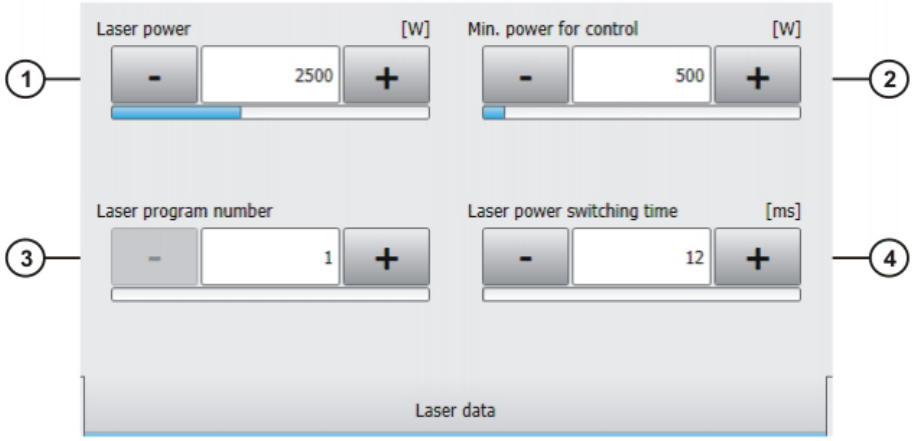

Fig. 7-47: Option window “Laser data” – Rectangle, Slot, Hexagon, Circle

Item	Description
1	Laser power at 100% velocity ■ **60 … 6,000 W**
2	Minimum power for velocity-dependent control of the laser power ■ **60 … 6,000 W** **Note**: This box is only displayed if the velocity-dependent laser power is activated (LSR_UsePwrVelCtrld = TRUE).

Item	Description
3	Laser program number ■ **1 … 200**
4	Laser power rise time Time that elapses after activation before the laser reaches full power ■ **1 … 2,000 ms** The maximum laser power rise time can be modified in the registry. (>>> 6.7 "Modifying maximum values for ramp times" Page 26)

7.7.8 Option window “Sensor parameters” and “Process parameters”

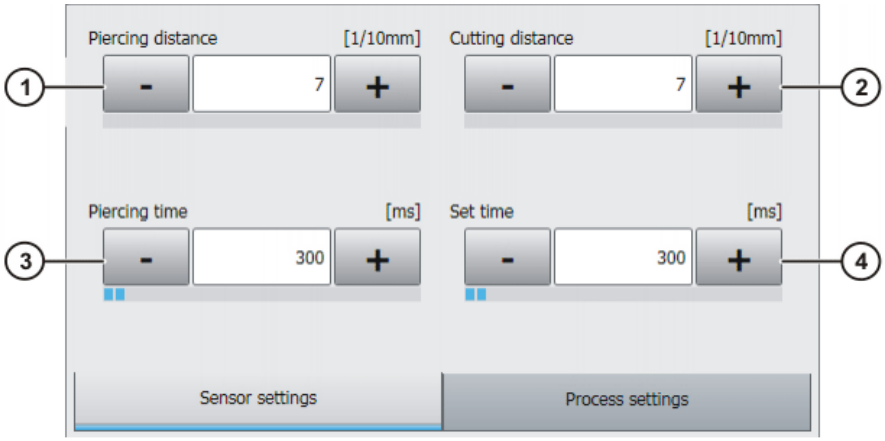

Fig. 7-48: Option window: Sensor parameters

Item	Description
1	Piercing distance (TCP of the sensor – component); unit: 1/10 mm ■ **0 … 300**
2	Cutting distance; unit: 1/10 mm ■ **0 … 300**
3	Piercing time ■ **0 … 3,000 ms**
4	Wait time after changing the cutting gas ■ **0 … 3,000 ms**

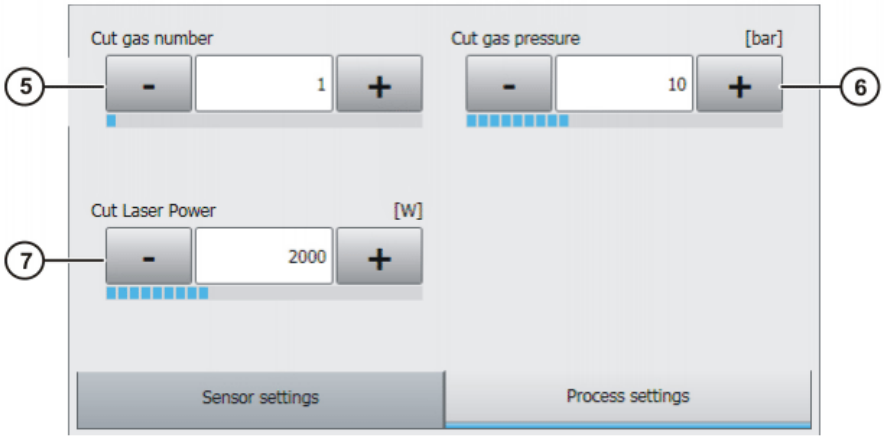

Fig. 7-49: Option window “Process parameters”

Item	Description
5	Cutting gas number ■ **0 … 30**
6	Cutting gas pressure during cutting ■ **0 … 30 bar**
7	Laser power during cutting ■ **60 … 6,000 W**

8 Example programs

8.1 Example program: step seam

The velocity of the laser must be kept constant until the switching point is reached. Otherwise it is possible that the laser may switch before or after the planned switching point.

Program

```
 1  DEF step( )
 2  INI
 3  PTP HOME  Vel= 100 % DEFAULT
 4  PTP Start CONT Vel=100 % PDAT0 Tool[1] Base[0]
 5  LSR WELD Allocation=True Gas: GasDef LSN: LSNDef
 6  LIN P1 CONT Vel=0.2 m/s CPDAT1 Tool[1] Base[0]
 7  GasSwi Proc_Gas ON
 8  GasSwi CrossJet ON Haltend
 9  LIN P2 CONT Vel=0.2 m/s CPDAT2 Tool[1] Base[0]
10  LSR StepOn Path=0 mm Dly=0 ms LSet=LS22 SSet=SP3
11  LIN P3 CONT Vel=0.1 m/s CPDAT3 Tool[1] Base[0]
12  LIN P4 CONT Vel=0.1 m/s CPDAT4 Tool[1] Base[0]
13  LSR WELD End Path=0 mm Min=100 W MSet=ME10 LSet=LS11 Release
14  LIN P5 CONT Vel=0.1 m/s CPDAT5 Tool[1] Base[0]
15  GasSwi All OFF
16  PTP HOME  Vel= 100 % DEFAULT
17  END
```

Description

Line	Description
5	Initializes the laser. The instruction carries out an implicit request. Light path and laser are selected. This instruction does not perform a reset. The robot motion is generally stopped due to handshake operations with the laser.
7	The process gas is switched on.
8	CrossJet is activated. **Continuous**: until `GasSwi All OFF`, the gas parameters (pressure, gas preflow time, gas postflow time) for all LaserOn, LaserSwi and LaserEnd instructions are ignored.
10	The next motion instruction executes a step seam. The overall length of the step seam and the number and length of the steps are defined in the option window **Step parameters**.
13	The laser power is switched off and the laser program terminated at the end point of the motion block LIN P5. The laser itself is not switched off.
15	All gases are deactivated.

8.2 Example program: gas and laser welding functions

Program

```
 1  DEF Gas()
 2  INI
 3  PTP HOME Vel=100 % DEFAULT
 4  PTP Start CONT Vel=100 % PDAT0 Tool[1] Base[0]
 5  GasInit    Gas: GasDef
 6  LIN P0 CONT Vel=0.2 m/s CPDAT6 Tool[1] Base[0]
 7  LSR   INIT Allocation=True Gas: GasDef LSN: LSNDef
 8  LIN P1 CONT Vel=0.2 m/s CPDAT1 Tool[1] Base[0]
 9  GasSwi Proc_Gas ON Pressure 4 bar Nicht Haltend
10  GasSwi CrossJet ON Nicht Haltend
11  GasSwi Root_Gas ON Nicht Haltend
12  LIN P2 CONT Vel=0.1 m/s CPDAT2 Tool[1] Base[0]
13  LSR   On Path=0 mm MSet=ME3 LSet=LS3
14  LIN P3 CONT Vel=0.1 m/s CPDAT3 Tool[1] Base[0]
15  LSR   Switch Path=0 mm MSet=ME4 LSet=LS4
16  LIN P4 CONT Vel=0.1 m/s CPDAT4 Tool[1] Base[0]
17  LSR   End Path=0 mm MSet=ME2 LSet=LS2 Release
18  LIN P5 CONT Vel=0.1 m/s CPDAT5 Tool[1] Base[0]
19  PTP HOME  Vel= 100 % DEFAULT
20  END
```

Description

Line	Description
5	Initializes the gases. This instruction is used to initialize the process and root gases. If gases are switched on/off with the GasSwi instruction, they must be initialized before the laser is initialized.
7	Initializes the laser. The instruction carries out an implicit request. Light path and laser are selected. This instruction does not perform a reset. The robot motion is generally stopped due to handshake operations with the laser.
9	The process gas is switched on.
10	CrossJet is activated.
11	The root gas is switched on.
13	The instruction refers to the next motion instruction: the laser program is started at the end point of the motion block LIN P3. If the laser has not yet been requested, it is now requested implicitly by means of this instruction. This causes the motion to stop.
15	Modification of the weld parameters. The instruction refers to the next motion instruction.
17	The laser power is switched off and the laser program terminated at the end point of the motion block LIN P5. The laser itself is not switched off. The instruction switches the gas off, as a GasSwi ON instruction has been programmed with the setting “Once”. It is not necessary to deactivate the gas with GasSwi OFF. The laser power is ramped down if a ramp time has been programmed.

8.3 Example program: set piercing and cutting data

Program

```
 1  DEF SetCut( )
 2  INI
 3  PTP HOME Vel=100 % DEFAULT
 4  PTP Start CONT Vel=100 % PDAT0 Tool[1] Base[0]
 5  LSR CUT Allocation=True Gas: GasDef LSN: LSNDef
 6  PTP P1 CONT Vel=10 % PDAT1 Tool[2] Base[0]
 7  LIN P2 CONT Vel=0.2 m/s CPDAT1 Tool[1] Base[0]
 8  LsrCut InData: CS1
 9  LsrCut Sensor=On InDLY=500 msec PgNo=1
10  LIN P3 CONT Vel=0.1 m/s CPDAT4 Tool[1] Base[0]
11  LIN P4 CONT Vel=0.1 m/s CPDAT5 Tool[1] Base[0]
12  LIN P5 CONT Vel=0.1 m/s CPDAT6 Tool[1] Base[0]
13  LsrCut Sensor=Hold InDLY=500 msec PgNo=1
14  LIN P6 CONT Vel=0.1 m/s CPDAT7 Tool[1] Base[0]
15  PTP HOME  Vel= 100 % DEFAULT
16  END
```

Description

Line	Description
5	Initializes the laser. The instruction carries out an implicit request. Light path and laser are selected. This instruction does not perform a reset. The robot motion is generally stopped due to handshake operations with the laser.
8	The piercing and cutting data are set.
9	The distance sensor is switched on. If InDLY > 0, piercing is carried out from a standstill.
13	The distance sensor remains in the current position.

8.4 Example program: piercing function

When the piercing function is called, the following piercing operation is executed:

1. The piercing data are set before the laser is switched on.
2. The robot waits at the start point of the cut (exact positioning).
3. The sensor is moved to the piercing distance.
4. Once the sensor has reached the piercing distance (LSCI_SnsrPosReached = TRUE), it remains in this position.
5. After a wait time (=piercing time), the sensor is set to the cutting distance.
6. The laser power is reduced to approx. 1% of the maximum power.
7. The cutting gas is changed.
8. The robot starts the laser cutting.

Program

```
 1  DEF Shape_einstechen( )
 2  INI
 3  PTP HOME Vel=100 % DEFAULT
 4  PTP Start CONT Vel=100 % PDAT0 Tool[1] Base[0]
 5  LSR CUT Allocation=True Gas: GasDef LSN: LSNDef
 6  LIN P6 CONT Vel=0.2 m/s CPDAT1 Tool[1] Base[0]
 7  GasSwi Cut_Gas ON Nicht Haltend
 8  GasSwi CrossJet ON Nicht Haltend
 9  LIN P7 CONT Vel=0.2 m/s CPDAT2 Tool[1] Base[0]
10  LsrCutHex Shape=GP1 P12 Vel=1 m/min MSet=ME20 LSet=LS22
    InData=CS1
11  LIN P8 CONT Vel=0.1 m/s CPDAT3 Tool[1] Base[0]
12  LSR Free
13  PTP HOME  Vel= 100 % DEFAULT
14  END
```

Description

Line	Description
5	Initializes the laser. The instruction carries out an implicit request. Light path and laser are selected. This instruction does not perform a reset. The robot motion is generally stopped due to handshake operations with the laser.
7	The cutting gas is switched on.
8	CrossJet is activated.
10	The piercing and cutting data are set. The piercing function is called and the distance sensor is switched on.
12	The laser is enabled.

9 Programming for system integrators

9.1 Configuring user-defined applications

Description

LaserTech can be expanded for up to 3 user-defined applications. These applications can then be selected, in the same way as WELD and CUT, as list entries in the inline forms for initializing and switching the laser.

In addition, a user-defined data set with up to 12 parameters can be created for each of these applications. This data set can then be selected in the inline forms for switching the laser and edited in an option window.

Precondition

- "Expert" user group

Procedure

1. In the main menu, select **Display** > **Variable** > **Single**.
   The **Variable display – Single** window is opened.
2. Set the variable LSR_USR_TECH to TRUE. The use of user-defined applications is enabled.
3. Assign one or more variables the values specified here in order to generate the desired list entries in the inline forms:
   - Assign TP_USR_ID the value #USR_LSR. Generates the list entry USR_LSR.
   - Assign TP_TCH_ID the value #USR_TCH. Generates the list entry USR_TCH.
   - Assign TP_LMB_ID the value #USR_LMB. Generates the list entry USR_LMB.
4. Set the variable LSR_USR_PL to TRUE. The option window with the user-defined data set can be displayed and edited.
5. To initialize the changes, reboot the robot controller with a cold restart.

9.1.1 Changing list entries in the inline forms

Description

The default list entries generated in the inline forms can be changed so that they match the user-defined application.

Precondition

- "Expert" user group
- To edit the file on the robot controller: Windows interface (smartHMI is minimized)

Procedure

1. Open the file C:\KRC\DATA\TPLASER_USR.KXR.
2. Search for the key of the desired list entry, e.g. LSR_LMD.
3. In the line <text xml:lang="de-DEV">…, enter the German text to be displayed in the list entry.
4. In the line <text xml:lang="en-DEV">…, enter the English text to be displayed in the list entry.
5. Save the file.
6. Reboot the robot controller with a cold restart (with the option **Reload files**).

Example

```
</uiText>
<uiText key="LSR_LMD">
   <text xml:lang="de-DEV">Test 1</text>
   <text xml:lang="en-DEV">test 1</text>
</uiText>
<uiText key="LSR_TCH">
  <text xml:lang="de-DEV">Test 2</text>
  <text xml:lang="en-DEV">test 2</text>
</uiText> <uiText key="LSR_USR">
  <text xml:lang="de-DEV">Test 3</text>
  <text xml:lang="en-DEV">test 3</text>
</uiText>
```

9.1.2 Changing parameter names and units in the option window

Description

The default parameter names and units generated in the option window can be changed so that they match the user-defined application.

Precondition

- "Expert" user group
- Windows interface (smartHMI is minimized).

Procedure

1. Open the file C:\KRC\DATA\TPLASER_USR.KXR.
2. Search for the key of the desired parameter, e.g. Val1 for the parameter name or Val1_U for the unit of the parameter.
3. In the line <text xml:lang="de-DEV">…, enter the German text or unit to be displayed in the list entry.
4. In the line <text xml:lang="en-DEV">…, enter the English text or unit to be displayed in the list entry.
5. Save the file.
6. Reboot the robot controller with a cold restart (with the option **Reload files**).

Example

```
<uiText key="Val1">
   <text xml:lang="de-DEV">Wert 1</text>
   <text xml:lang="en-DEV">Value 1</text>>
</uiText>
<uiText key="Val1_U">
   <text xml:lang="de-DEV">mm</text>
   <text xml:lang="en-DEV">mm</text>
</uiText>
```

9.2 Integration of user-defined functions

Overview

Within the LaserTech standard package, functions of different interfaces are called. In each case, this involves the transfer of a command as ENUM, an integer parameter and a function argument.

Interface	Call
LSR_Tech_IFC (>>> 9.3.1 "Interface to the laser process LSR_Tech_IFC" Page 70)	LSR_Tech_IFC(#CMD, x, y) Call defined in Lsr_Tech_IC.src
LSR_Lsr_IFC (>>> 9.3.2 "Interface to the laser control LSR_Tech_IFC" Page 72)	LSR_Lsr_IFC(#CMD, x, y) Call defined in LSR_Lsr_IC.src

Interface	Call
LSR_Media_IFC (>>> 9.3.3 "Interface to media LSR_Media_IFC" Page 72)	LSR_Media_IFC(#CMD, x, y) Call defined in Lsr_Media_IC.src
LSR_Err_IFC (>>> 9.3.4 "Interface to error handling LSR_ERR_IFC" Page 73)	LSR_Err_IFC(#CMD, x, y) Call defined in Lsr_Err_Ic.src

Example

By way of example, the interface function call is described here for the interface to the laser process LSR_Tech_IFC.

If only LaserTech is used, the file Lsr_Tech_IC.src has the following structure:

```
 1  DEF Lsr_Tech_IC()
 2  END
 3  Global DEF  LSR_Tech_IFC (Action :In, CallID :IN, Arg :IN)
 4    ;***********************************************
 5    ;* Interface to the different laser technologies *
 6    ;*                                               *
 7    ;* Date: 02.2013                                 *
 8    ;*                                               *
 9    ;***********************************************
10   DECL Tech_Interface Action
11   DECL INT CallID
12   DECL INT Arg
13 ;Fold Tech Interfaces
14 ;ENDFOLD (TechInterfaces)
15 END ;(LSR_TECH_IFC)
```

Line	Description
3	Declaration of the global subprogram LSR_Tech_IFC Interface to the laser process
10	Action currently being executed
11	If there are a number of tasks for one action, these are distinguished by the CallID.
12	Open parameter for user-defined expansion

If the LaserWeld or LaserCut option is used in addition, a fold is inserted during installation in which the TechHandle of the respective option is polled. If the TechHandle is then set in a higher-level function, the specific function for LaserWeld or LaserCut is called and executed.

```
 1  DEF Lsr_Tech_IC()
 2  END
    ...
13 ;Fold Tech Interfaces
14 ;Fold Weld Interfaces
15 IF TechHandle == TP_Weld_ID THEN
16   LSW_TECH_IFC(Action, CallID, Arg)
17 ENDIF
18 ;ENDFOLD (WeldInterfaces)
19 ;ENDFOLD (TechInterfaces)
20 END ;(LSR_TECH_IFC)
```

Line	Description
15 … 17	Polling the TechHandle of the LaserWeld option

To expand LaserTech with user-specific functions, a corresponding TechHandle must be programmed.

```
 1  DEF Lsr_Tech_IC()
 2  END
    ...
13 ;Fold Tech Interfaces
14 ;Fold Weld Interfaces
15 IF TechHandle == TP_Weld_ID THEN
16   LSW_TECH_IFC(Action, CallID, Arg)
17 ENDIF
18 IF TechHandle == #LSR_LMD THEN
19    LSW_LMD_IFC(Action, CallID, Arg)
20 ENDIF
21 ;ENDFOLD (WeldInterfaces)
22 ;ENDFOLD (TechInterfaces)
23 END ;(LSR_TECH_IFC)
```

Line	Description
18 … 20	Polling the TechHandle of an additional user-specific function
19	Within the subprogram LSW_LMD_IFC, which must be created separately, the user-specific function calls are programmed. The name of the subprogram is freely selectable.

9.3 Interfaces for functional expansions

9.3.1 Interface to the laser process LSR_Tech_IFC

Action	CallID	Arg	Call	Description
Tech_ON	0	0	lsr_err_handler.src LSR_RESTART_LASER;262	Call if the restart option *Hot* is selected as the response in the dialog displayed after an error.
	1	0	lsr_MainFunc.src LSR_ON;613	At the start of the procedure
	2	0	lsr_MainFunc.src LSR_ON;634	Before setting the sync input (e.g. LSRI_LsrSet3)
	3	0	lsr_MainFunc.src LSR_ON;637	After setting Start static
	4	0	lsr_MainFunc.src LSR_ON;640	Activation not permitted, before ramping down the laser
	5	0	lsr_MainFunc.src LSR_ON;649	Activation not permitted, after enabling of the laser
	6	0	lsr_MainFunc.src LSR_ON;654	At the end of LaserOn
Tech_Pre_ON	0	0	lsr_MainFunc.src LSR_PRE_ON;526	At the start of the function
	1	0	lsr_MainFunc.src LSR_PRE_ON;541	At the end of the function

Action	CallID	Arg	Call	Description
Tech_Swi	1	0	lsr_MainFunc.src LSR_Swi;668	At the start of the function
	2	0	lsr_MainFunc.src LSR_Swi;702	After power change
	3	0	lsr_MainFunc.src LSR_Swi;731	After executing the switch action
	4	0	lsr_MainFunc.src LSR_Swi;733	At the end of the function
Tech_Pre_Swi	1	0	lsr_MainFunc.src LSR_Pre_Swi;554	At the start of the function
	2	0	lsr_MainFunc.src LSR_Pre_Swi;576	At the end of the function
Tech_Off	1	0	lsr_MainFunc.src LSR_Off;746	At the start of the function
	2	0	lsr_MainFunc.src LSR_Off; 762	As preparation for the next section with laser power
	3	0	lsr_MainFunc.src LSR_Off;770	At the end of the function
Tech_Pre_Off	1	0	lsr_MainFunc.src LSR_Pre_Swi;588	At the start of the function
	2	0	lsr_MainFunc.src LSR_Pre_Swi;598	At the end of the function
TECH_RELDEVICE	0	0	lsr_MainFunc.src LSR_PLC; 60	Monitoring of whether the robot interpreter is running
TECH_INIT	0	0	lsr_MainFunc.src LSR_INIT_LASER; 191	If Lsr_alloc = True, after enabling of the laser
TECH_INITNOALLOC	0	0	lsr_MainFunc.src LSR_INIT_LASER; 196	If Lsr_alloc = False, after enabling of the laser
TECH_INIT_SNSR	0	0	lsr_MainFunc.src LSR_INIT_LASER; 199	After complete initialization
TECH_RESET	0	0	lsr_MainFunc.src Lsr_Reset_Flags; 231	At the end of the function
TECH_RELDEVICE	0	0	lsr_MainFunc.src LSR_LASER_OFF; 287	After deactivation, before Standby is removed
TECH_INITPERI	0	0	lsr_MainFunc.src LSR_InitCheckPeripherals; 331	Before the gas check
TECH_NOMOTION	0	0	lsr_MainFunc.src LSR_StillstandControl; 331	If standstill monitoring triggered, after deactivation
TECH_PRE_STEP	1	0	lsr_MainFunc.src LSR_PRE_Step; 801	At the start of the function

9.3.2 Interface to the laser control LSR_Tech_IFC

Action	CallID	Arg	Call	Description
LSR_ON_RDY	0	0	lsr_TR_IFC.src LSR_ON_AND_READY; 150	At the end of the function
LSR_TECHSTOP	0	0	lsr_TR_IFC.src LSR_ANOUT_TECHSTOP; 579	At the end of the function, if power was activated
LSR_ISR_STOP	0	0	lsr_TR_IFC.src LSR_ANOUT_ISR_STOP; 591	At the start of the function, if power was activated
LSR_ISRRESTORE	0	0	lsr_TR_IFC.src LSR_ANOUT_ISR_RESTORE; 612	At the start of the function, if power was activated

9.3.3 Interface to media LSR_Media_IFC

Action	CallID	Arg	Call	Description
Tech_ON	1	fswi	Lsr_MediaFunc.src LSR_GAS_SWI;432	Switch on all gases, TechHandles #Tech and #Weld
	2	fswi	Lsr_MediaFunc.src LSR_GAS_SWI;434	Switch on all gases, all other TechHandles
	3	ipressure	Lsr_MediaFunc.src LSR_GAS_SWI;445	Switch root gas if Lsr_RootFlag = false
	4	ipressure	Lsr_MediaFunc.src LSR_GAS_SWI;451	Switch root gas if Lsr_RootFlag = false, second call
	5	ipressure	Lsr_MediaFunc.src LSR_GAS_SWI;454	Switch on cutting gas, before valves opened
	6	ipressure	Lsr_MediaFunc.src LSR_GAS_SWI;456	Switch on cutting gas, after valves opened
GAS_INIT	0	0.0	LSR_InitGas.src LSR_InitGas;44	After cycflag definition, TechHandle #CUT, #WELD
	11	0.0	LSR_InitGas.src LSR_InitGas;51	After cycflag definition, all other TechHandles
TECH_CHECK_GAS	0	0.0	lsr_MainFunc.src LSR_GAS_CHECK;104	If TechHandle #Weld or Lsr_usrootflag = true
	11	0.0	lsr_MainFunc.src LSR_GAS_CHECK;97	If TechHandle #Tech

9.3.4 Interface to error handling LSR_ERR_IFC

Action	CallID	Arg	Call	Description
ERR_SENSOR	0	0	lsr_err_handler.src LSR_RESTART_LASER; 202	Call if the restart option *Cold* is selected as the response in the dialog displayed after an error. This call is the last call in the branch.
	1	0	lsr_err_handler.src LSR_RESTART_LASER; 217	Call if the restart option *Seam cold* is selected as the response in the dialog displayed after an error. This call is the last call in the branch.
	2	0	lsr_err_handler.src LSR_RESTART_LASER; 236	Call if the restart option *Cold section* is selected as the response in the dialog displayed after an error. This call is the last call in the branch.
	3	0	lsr_err_handler.src LSR_RESTART_LASER; 236	Call if the restart option *Hot* is selected as the response in the dialog displayed after an error. This call is the first call in the branch.
	4	0	lsr_err_handler.src LSR_SENSOR_ERROR, 544	If the error is a sensor error, this call is made after deactivation of the laser.
ERR_LASER_SAFETY	0	0	lsr_err_handler.src LSR_LASER_SAFETY(); 27	After the process has been deactivated, technology-specific actions may be executed here.
	1	0	lsr_err_handler.src LSR_LASER_SAFETY(); 68	After dialogs have been responded to and the cause of the error has been eliminated, technology-specific actions and further dialogs may be executed here.
ERR_GAS	0	0	lsr_err_handler.src LSR_MEDIA_ERROR();121	After all default handling strategies after a gas error have been carried out, a technology-specific code may be executed.
ERR_WIRE	0	0	lsr_err_handler.src LSR_MEDIA_ERROR();126	The call takes place after the technology-specific gas action and the user gas action.
ERR_MEDIA	0	0	lsr_err_handler.src LSR_RESTART_LASER; 239	Call if the restart option *Hot* is selected as the response in the dialog displayed after an error.

Action	CallID	Arg	Call	Description
ERR_RESTART	1	0	lsr_err_handler.src LSR_RESTART_LASER; 208	As preparation for the next seam with laser power.
	2	0	lsr_err_handler.src LSR_RESTART_LASER; 228	As preparation for the next section with laser power.
	3	0	lsr_err_handler.src LSR_RESTART_LASER; 250	Error handling is completed, the laser is ready to continue welding.
	4	0	lsr_err_handler.src LSR_RESTART_LASER; 259	Laser restart procedure
	5	0	lsr_err_handler.src LSR_RESTART_LASER; 274	Laser restart procedure failed.
ERR_SHUTDOWN	0	0	lsr_err_handler.src SHUT_DOWN_PROCESS; 341	In the event of an error, after termination of the process
	11	0	lsr_err_handler.src SHUT_DOWN_PROCESS; 355	In the event of an error, after the process has reached the end of the shutdown routine
ERR_LSR_INIT	0	0	lsr_err_handler.src LSR_ISR_INIT_LASER; 450	If an error was triggered, due to an interrupt, on starting re-initialization
	11	0	lsr_err_handler.src LSR_ISR_INIT_LASER; 457	If an error was triggered, due to an interrupt, on completing re-initialization

10 Messages

10.1 Basic laser function messages

Message	Description/remedy	Key
Collision protection device triggered! Please move the robot clear in Test1 or Test2 mode	A collision has occurred. ■ Move away from the collision in T1 or T2 mode. ■ Resume program execution or reset program and laser.	CollissionDetected
The laser shutter will be closed during block selection	For safety reasons, use of the laser power is prevented during block selection.	LaserShutDownAtBlockSelect
Laser is still not activated: No LASER ON state	Possible causes: ■ The laser is not switched on. ■ The laser is currently being reset. ■ The laser is in manual mode.	NoLaserOnStatus
No laser application possible without crossjet!	■ Activate CrossJet. ■ Acknowledge the message. ■ Resume or restart program.	MissingCrossJet
Block command failed.	An error has occurred during execution of a technology-specific instruction. Please contact the Service Department if this error recurs.	BlockCommandFailed
No valid inline form	An error has occurred during execution of a technology-specific instruction. Please contact the Service Department if this error recurs.	NoInlineForm
Wrong value of $PRO_I_O[] ($CUSTOM.DAT) or no submit routine selected	■ Deselect program. ■ Deselect Submit. ■ Change value, start Submit.	WrongSubmitInterpreter
Error message at laser system	■ Eliminate laser error. ■ Acknowledge the message. ■ Resume or restart program.	ErrorAtLaser
Continuing the process only sensible with correct operating mode and previous overide value!	A collision has occurred. ■ Move away from the collision in T1 or T2 mode. ■ Reset program and laser.	CollissionCorrectModeOperation
Internal error!	An error has occurred during execution of a technology-specific instruction. Please contact the Service Department if this error recurs.	InternalError
No gas available! Please check gas equipment	This error message is triggered by the process gas monitoring.	NoGasFlow

Message	Description/remedy	Key
Laser is not available and shutter is closed	Possible causes: ■ A required signal has not been generated or was not detected by the laser. ■ Error in the laser controller	NoLaserActive-AndShutter-Closed
No feedback of the laser by external control	The signal LSRI_LsrExternEnabled is not generated. Possible causes: ■ The laser is not switched on. ■ The laser is currently being reset. ■ The laser is in manual mode.	NoExternMode-Possible
Laser is still not in standby mode	Possible causes: ■ A required signal has not been generated or was not detected by the laser. ■ Error in the laser controller	LaserStillNotIn-Standby
Laser still not ready or not assigned	The laser program cannot be started. Possible causes: ■ The laser is not switched on. ■ The laser is currently being reset. ■ The laser is in manual mode.	LaserStill-NotReady
Laser flags critical error to cell control	An error has occurred in the laser periphery. Depending on the configuration, this may also be a robot error.	LsrExternError
Laser still waiting for allocation	The instruction LSR Allocate has been called. The laser is not free, however. This message is displayed during the wait time.	LaserWaiting-ForAllocation
Laser error -> Details on console of laser system	Refer to message on the laser console.	DetailsToLsrErrorsOnConsole
Laser error -> Details on laser console ---> Resumption of program after laser reset	Refer to message on the laser console.	LsrErrorLookOn-Console
Laser error has occurred	■ Eliminate laser error. ■ Acknowledge the message. ■ Resume or restart program. Depending on the nature of the error, the message “ErrorAtLaser” may also be generated.	LaserErrorAvail-able
Invalid laser command -> LASER INIT command necessary	An invalid laser command has been initiated. A program reset is generally required.	LaserCommand-IncompatibleTo-Package

Message	Description/remedy	Key
Laser program was canceled	The laser signals the cancelation of an active program. Possible causes: ■ The signal LSRO_LsrReset is set during an active program. ■ The signal LSRO_LsrStartStatic is reset before the signal LSRO_LsrStopProgram has been set.	LsrProgramCancel
Laser program could not be activated: Please check errors on laser console	Possible causes: ■ A required signal has not been generated or was not detected by the laser. ■ Error in the laser controller	NotProgramActive
Laser was switched to manual mode ---> Resumption of process after laser reset	Cause: Manual mode has been forced on the laser console.	LsrInManualMode
Check media control!	■ Eliminate media error. ■ Acknowledge the message. ■ Resume or restart program.	CheckMediaControl
Periphery not in a safe state	■ Check the safety equipment. ■ Eliminate problem. ■ Reset program and laser.	LsrPeripheryNotSafe
Complete program will be continued without active process. Resumption with active process by executing LASER_INIT command	Cause: Following an error, this option (= continue complete program without active process) has been selected as a response in a dialog window.	CompleteColdRun
Cold run selected	Cause: The program is executed without laser power. The status key “Laser off” is displayed. Remedy: Activate the laser using the status key.	NoLsrControlColdRun
Program was aborted or external error signal active	■ Eliminate problem. ■ Acknowledge the message. ■ Resume or restart program.	ProgAbortOrExtFailure
No process gas!	■ Activate process gas. ■ Acknowledge the message. ■ Resume or restart program.	MissingProcessGas
Please acknowledge errors on laser console first	Laser errors cannot be reset from the robot.	LsrReceiptMessage
Robot was stopped by an interpreter stop	The robot interpreter has been stopped by: ■ STOP key ■ EMERGENCY STOP ■ Operator safety ■ Operating mode change ■ Releasing the enabling switch	LsrInTechStop

Message	Description/remedy	Key
Laser safety circuit is still open: Ensure laser safety before the robot program is resumed	Possible causes: ■ The safety circuit is open. ■ Light path settings in the laser do not match the requested light path.	SikContactOpen
Safety circuit open, shutter closed	Possible causes: ■ The safety circuit is open. ■ Light path settings in the laser do not match the requested light path.	ShutterOpen
Standstill monitoring: Laser was switched off because robot welded for too long at the same position	If welding is to be carried out for longer at a specific position, i.e. without robot motion, the value of LSR_Stop_InspectionTime must be increased.	RobotStandStill
Standstill monitoring: Laser has not been used for a long time and has just been shut down	The interval after which the laser is deactivated can be increased in the configuration. (LSR_LaserStandbyDelay)	LaserStandStill
Robot stopped ---> Resumption of the process	■ Eliminate cause of the stop reaction. ■ Answer the dialog and resume or restart the program.	LsrRobotError
Error of laser system ---> Resumption of process possible after dialog and forced reset of laser	Refer to message on the laser console.	CollectionErrorOfLaser
Test commands only possible in operating mode Test1 or Test2!	■ Change operating mode. ■ Restart the program.	NoFocusPulsInAutomatic
Invalid parameter list	An error has occurred during execution of a technology-specific instruction. Please contact the Service Department if this error recurs.	ParamListHandleUnknown
Insufficient gas pressure! Please check gas equipment.	■ Eliminate problem. ■ Reset program.	NotEnoughGasPressure
No root gas!	■ Activate root gas. ■ Acknowledge the message. ■ Resume or restart program.	MissingRootGas
Cell or laser safety error. Check safety equipment!	■ Eliminate problem. ■ Acknowledge the message. ■ Resume or restart program.	LsrCellOrSafetyError
Gas pressure too low. The current program will be aborted. Please check gas !!!	■ Correct the gas pressure. ■ Acknowledge the message. ■ Resume or restart program.	LastPartToLessGas
Laser allocation denied	Possible causes: ■ The laser is allocated to a different station. ■ The laser is in manual mode. ■ An error has occurred.	LaserAllocationAvoided

10.2 LaserCut messages

Message	Description/remedy	Key
Error in user-defined sensor code!	An error has occurred within the user-defined function so that the return value <> 0. Remedy: Eliminate the error and ensure that the return value = 0.	ErrorInUserDef-SnsrProc
Function not implemented!	A non-implemented function has been called. Please inform the Service Department.	NOT_IMPLEMENTED
Initialization of user-defined sensor code failed!	An error has occurred within the user-defined function so that the return value <> 0. Remedy: Eliminate the error and ensure that the return value = 0.	InitOfUserDef-SensorFailed
Programmed position not reached	■ Reset the sensor using the sensor controller. ■ Reset program.	NoProgPos
Sensor error	Eliminate the sensor controller error and acknowledge the message.	SnsrError
Sensor cable interrupted!	■ Eliminate problem. ■ Reset program.	SnsrCableError
Collision monitoring	The distance sensor signals a collision. Eliminate the sensor controller error and acknowledge the message.	SnsrCollision
Use of a reserved sensor type!	An attempt has been made to initialize a reserved sensor type within a user-defined function.	UseOfReseverd-SnsrType

10.3 LaserWeld messages

Message	Description/remedy	Key
Wire or wirefeeder not available	■ Check wire feed system. ■ Check configuration for the wire feed system in the robot controller.	WireFeeder-NotReady
Please acknowledge errors of the wirefeed unit	■ Acknowledge message on wire feed system. ■ Acknowledge this message on the robot controller.	WfdReceiptMessage
Please acknowledge errors on the wire heater unit	■ Acknowledge message on the welding wire heater. ■ Acknowledge this message on the robot controller.	AcknWfdHeat-Message
Wire heater error	■ Eliminate error in the wire heater. ■ Acknowledge the message.	WireFeedHeat-Problem

11 Appendix

11.1 Configuring LaserTech

11.1.1 LaserTech: analog inputs/outputs, interrupts, timers and cyclical flags

The numbers for inputs/outputs, interrupts, timers and cyclical flags must only be assigned once in the entire robot controller.

NOTICE Incorrect configuration of the internal analog channels can result in the laser working with incorrect parameters. Damage to the system may result.

Analog outputs

Outputs 1 to 32 are available.

Output	Description	Default
LSRO_LsrPwr	Analog channel for the laser power	2
LSRO_GasPressure	Analog channel for gas pressure	4

Analog inputs

Inputs 1 to 32 are available.

Output	Description	Default
LSRI_GasPressure	Analog channel for gas pressure	4

Interrupts

NOTICE If the priority of the interrupts is changed, this may result in a double assignment. Furthermore, the interrupts for the LaserTech monitoring functions may receive a priority that is so low that they are processed too late. This can cause damage to the system.

Interrupts 1 to 39 are available.

Interrupt	Description	Default
LSR_InterrAntiCollission	Interrupt number for the anticollision monitoring	7
LSR_InterruptLaserSafety	Interrupt number for the laser safety. The error states of the laser are monitored.	8
LSR_InterruptDistSensor	Interrupt number for the distance sensor	9
LSR_InterruptMedias	Interrupt number for the media controller.	10
LSR_InterruptStepMon	Interrupt number for the step seam monitoring	11
LSR_AnoutCheck	Interrupt number for monitoring of the laser power on analog channel LSRO_LsrPwr	12
LSR_InterruptUsrTech	Only relevant if user-defined applications are used and these require a separate interrupt Interrupt number for monitoring a user-specific function	30

Timer Timers 1 to 32 are available.

Timer	Description	Default
LSR_TC_PostGas	Timer number for the gas postflow time	15
LSR_TC_PreFlowGas	Timer number for the gas preflow time	16

Timer	Description	Default
LSR_TC_STEP	Timer number for the step function	17
LSR_TC_Check	Timer number for internal timeouts, e.g. gas monitoring or checkback signals of the laser	18

Cycflags

NOTICE If the number of cyclical flags is changed, this may result in a double assignment. Furthermore, the numbers of the cyclical flags for the LaserTech monitoring functions may be overwritten. This can cause damage to the system.

Cycflags 1 to 32 are available.

Cycflag	Description	Default
LSR_CF_GasCtrl	Cycflag number for the gas controller	13
LSR_CF_STEPCTRL	Cycflag number for the step seam monitoring	28
LSR_CF_STEP	Cycflag number for the step controller	29
LSR_CF_LaserCtrl	Cycflag number for the laser monitoring	30
LSR_CF_AnoutCheck	Cycflag number for monitoring of the laser power on analog channel LSRO_LsrPwr	31
LSR_CF_MediaCtrl	Cycflag number for the media monitoring	32
LSR_CF_UsrTech	Only relevant if user-defined applications are used and these require a separate interrupt Cycflag number for monitoring a user-specific function	27

11.1.2 LaserTech: signal outputs to the laser

Detailed information about the laser controller is contained in the TRUMPF documentation.

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERTECH GLOBALS

LASER OUTPUTS

Signal	Description	Type	$OUT[]
LSRO_LsrRequest	Request laser.	BOOL	97
LSRO_LsrPilotOn	Switch pilot laser on.	BOOL	98
LSRO_LsrSync1	Synchronize laser with robot (1). Query whether laser is ready. **Note**: By default, the robot controller uses LSRO_LsrSync1 for the query.	BOOL	103
LSRO_LsrSync2	Synchronize laser with robot (2). Query whether laser is ready.	BOOL	102
LSRO_LsrFaultExtern	Robot fault (fault that is external to the laser controller)	BOOL	104
LSRO_LsrReset	Reset laser.	BOOL	105
LSRO_LsrStopProgram	Stop laser program.	BOOL	106
LSRO_LsrStartDynamic	Laser program start dynamic	BOOL	107
LSRO_LsrStartStatic	Laser program start static	BOOL	108

Signal	Description	Type	$OUT[]
LSRO_LsrStandby	Set laser to standby.	BOOL	109
LSRO_LsrOn	Switch laser on.	BOOL	110
LSRO_LsrOperationOff	Disable laser console.	BOOL	111
LSRO_LsrExternControl	Enable external control.	BOOL	112
LSRO_LsrPrgNrBCD10	BCD code program number upper bits*	4 bits	117 … 120
LSRO_LsrPrgNrBCD1	BCD code program number lower bits*	4 bits	113 … 116
LSRO_LsrPrgSetDual	Laser program number binary coded*	Byte	113 … 120
LSRO_LsrFiber	Light path number	Byte	121 … 128
LSRO_LsrLaserNr	Laser number	Byte	129 … 136
LSRO_LsrRobotNr	Robot number	Byte	137 … 144
LSRO_LsrDataWord0	Laser data word 0	Word	97 … 112
LSRO_LsrPwr	Analog channel for the laser power $ANOUT[2]	INT	—
LSRO_LsrDataWord3	Laser data word 3	Word	113 … 128
LSRO_LsrDataWord4	Laser data word 4	Word	193 … 208
LSRO_LsrRampTime	Ramp length	Word	145 … 160
LSRO_LsrRmpUpStartVal	Ramp start value (ramp up)	Word	257 … 272
LSRO_LsrRmpUpEndVal	Ramp end value (ramp up)	Word	273 … 288
LSRO_LsrRmpDownStartVal	Ramp start value (ramp down)	Word	289 … 304
LSRO_LsrRmpDownEndVal	Ramp end value (ramp down)	Word	305 … 320

* Whether program numbers are transferred as BCD coded or binary coded values depends on the variable LSR_MPI_Interface (>>> 11.1.7 "LaserTech: process options" Page 86).

11.1.3 LaserTech: signal inputs from the laser

Detailed information about the laser controller is contained in the TRUMPF documentation.

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERTECH GLOBALS

LASER INPUTS

Signal	Description	Type	$IN[]
LSRI_LsrWarnLampOn	Laser warning lamps are on.	BOOL	97
LSRI_LsrPilotOn	Pilot laser is on.	BOOL	98
LSRI_LsrAssigned	Laser is assigned.	BOOL	100
LSRI_LsrInternFault	Internal laser fault	BOOL	101
LSRI_LsrFailure	Laser monitoring message The robot stops.	BOOL	102
LSRI_LsrShutterClosed	Shutter is closed.	BOOL	103
LSRI_LsrSet3	Sync input 3 **Note**: By default, the robot controller polls sync input 3.	BOOL	106
LSRI_LsrSet2	Sync input 2	BOOL	105
LSRI_LsrSet1	Sync input 1	BOOL	104
LSRI_LsrProgAbort	Laser program canceled.	BOOL	107
LSRI_LsrProgEnd	End of laser program.	BOOL	108
LSRI_LsrProgActive	Program is active.	BOOL	109
LSRI_LsrStandby	Laser is in standby.	BOOL	110
LSRI_LsrActive	Laser is active.	BOOL	111
LSRI_LsrExternEnabled	External control is enabled.	BOOL	112
LSRI_LsrFiberNo	Enabled light path number	Word	145 … 160
LSRI_LsrFiberSafetyCode	Light path number via safety box	Word	161 … 176

11.1.4 LaserTech: signal outputs to the welding periphery

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERTECH GLOBALS

INTEGRATION peripheri devices

Signal	Description	Type	$OUT[]
LSRO_Error_Cell	Cell error (flag to PLC)	BOOL	501
LSRO_Error_Media	Media error (flag to PLC)	BOOL	501
LSRO_AntiCollissionDev	Collision monitoring (flag to PLC)	BOOL	502
LSRO_Error_Sensor	Sensor error (flag to PLC)	BOOL	503
LSRO_ColdFor1Section	The next seam section is executed without power (flag to PLC) A section is defined as what comes between the instructions **Activate process**, **Switch process** and **Deactivate process**.	BOOL	504
LSRO_ColdFor1Seam	The next seam is executed without power (flag to PLC). A seam is defined as what comes between the instructions **Activate process** and **Deactivate process**.	BOOL	505

Signal	Description	Type	$OUT[]
LSRO_ColdForEver	Without power until the next laser initialization (flag to PLC)	BOOL	506
LSRO_ColdApplication	The complete program is executed without power (flag to PLC).	BOOL	507
LSRO_CrossJet	Activate/deactivate CrossJet.	BOOL	515
LSRO_GasPressure	Only relevant if a proportional gas valve is used (LSR_PropGasValve = TRUE). Number of the analog channel for the gas pressure $ANOUT[4]	INT	—
LSRO_GasEnable	Only relevant if a proportional gas valve is used (LSR_PropGasValve = TRUE). Output enable the selected gas **Note**: Normally used with an additional main valve.	BOOL	72

11.1.5 LaserTech: signal inputs from the welding periphery

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERTECH
GLOBALS INTEGRATION peripheri devices

Signal	Description	Type	$IN[]
LSRI_AntiCollisionDev	This input can be used for collision monitoring.	BOOL	1025
LSRI_UsrInput1	These user-specific inputs can be used to integrate customer signals into the process monitoring in order to stop the process in the event of a fault.	BOOL	1025
LSRI_UsrInput2		BOOL	1025
LSRI_CrossJet	Checkback CrossJet OK	BOOL	1025
LSRI_GasPressure	Only relevant if a proportional gas valve is used (LSR_PropGasValve = TRUE). Number of the analog channel for the gas pressure $ANIN[4]	INT	—

11.1.6 LaserTech: system outputs and system flags

The variables described in this section can be found in the file Laser.dat in the directory R1\TP\LaserTech. To display or change the values, select **Display** > **Variable** > **Single** from the main menu.

Variable	Description
S_Int_Flag	Submit watchdog This digital output can be used together with the variable S_Int_Cycl to monitor whether the submit interpreter is running cyclically. The monitoring only works usefully if this output is continuously TRUE. To achieve this, the value of S_Int_Cycl must be a little higher than the cycle time of the SPS.SUB program. (>>> 11.1.8 "LaserTech: process constants" Page 88) Default: **765**
LSRO_Error_Bypass	Masking of digital input events If an interrupt is activated while the condition for this interrupt is met, e.g. because the corresponding cycflag is true, then the interrupt cannot trigger. The output LSRO_Error_Bypass is used to set the cycflag via a pulse instruction to ensure that the condition is not met at the point in time at which the interrupt is activated. At the end of the pulse, the interrupt can react. This digital output is used internally during monitoring of the process. The output may only be used once. Default: **601**
AnoutBypass	Masking of analog input events (functionality as with LSRO_Error_Bypass) This digital output is used internally during monitoring of the process. The output may only be used once. Default: **602**
LSR_UserErrorFLAG	To allow other installed options to interrupt the laser process, this variable can be set to FALSE. The interrupt is then triggered and the process terminated.

11.1.7 LaserTech: process options

The variables described in this section can be found in the file Laser.dat in the directory R1\TP\LaserTech. To display or change the values, select **Display** > **Variable** > **Single** from the main menu.

Variable	Description
LSR_MPI_Interface	Coding of the program number TRUE = Program number is transferred as a binary-coded value, i.e. as an 8-bit binary number (00 … 255). FALSE = Program number is transferred as a BCD-coded value, i.e. 4 bits for the units and 4 bits for the tens of the program number (00 … 99). Default: TRUE
LSR_CrossJetOption	Activate/deactivate CrossJet. TRUE = CrossJet is activated on initialization of the laser and deactivated at the end of the program. FALSE = CrossJet is activated and deactivated via the inline forms **Activate process**, **Deactivate process** and **Switch gas**. Default: FALSE

Variable	Description
LSR_UsePwrVelCtrld	Activate/deactivate the velocity-dependent laser power. TRUE = Laser power is dependent on the robot velocity. FALSE = Laser power remains constant at the value entered in the inline form. Default: FALSE
LSR_LsrFiberMirrorOption	Activate/deactivate mirroring of the light path number. TRUE = The laser fiber number mirrored by the laser controller is evaluated. FALSE = The laser fiber number mirrored by the laser controller is not evaluated. Default: FALSE
LSR_UseGas	Use gas when executing the program. TRUE = The programs are executed with gas. FALSE = The programs are executed without gas. This is suitable, for example, for test purposes where no gas is desired. Default: TRUE **Note**: Gases selected in the inline form **Switch gas** are nonetheless activated if LSR_UseGas = FALSE.
LSR_NoProc	Do not use gas when executing the program without laser power. TRUE = Gas is not activated when executing the program without laser power. FALSE = Gas is activated when executing the program without laser power. Default: TRUE
LSR_PropGasValve	Only relevant if process or cutting gases are used, not relevant for root gases and CrossJet. Use proportional gas valve. TRUE = The gas pressure can be defined in the inline form **Switch gas**. FALSE = The gas pressure cannot be defined in the inline form **Switch gas**. Default: FALSE The value of this variable also influences which properties can be defined for the gases. (>>> 6.5 "Configuring the inputs/outputs for gases and other properties" Page 24) **Note**: If this variable is modified, the robot controller must be rebooted with a cold start.

Variable	Description
LSR_MIN_STBY	Reduce the standby power. TRUE = The standby power is automatically reduced to 1% of the maximum power. A precondition is that a laser is being used for which the minimum standby power can actually be reduced to 1%. FALSE = The standby power is automatically reduced to 10% of the maximum power. Default: TRUE **Note**: If this variable is TRUE, no ramps can be executed.
LSR_UseRootFlag	Use root gas (precondition: LaserWeld is installed). TRUE = Root gas can be selected in the inline form **Initialize gas** without the **WELD** application being selected. The weld operation can then be programmed with LaserTech instructions; LaserWeld instructions are not required in the KRL program. FALSE = Root gas can only be selected in the inline form **Initialize gas** if the **WELD** application is selected. Default: FALSE **Note**: If this variable is modified, the robot controller must be rebooted with a cold start.

11.1.8 LaserTech: process constants

The specified ranges of values contain the values that will be accepted by the system. They do not, however, constitute a recommendation of which values are useful in practice.

The variables described in this section can be found in the file Laser.dat in the directory R1\TP\LaserTech. To display or change the values, select **Display** > **Variable** > **Single** from the main menu.

Variable	Description
LSR_PulsTime	Pulse duration for the reset signal to acknowledge a laser fault. ■ **0 … 9,999 s** Default: **0.1 s**
LSR_Timeout	Maximum wait time for a response from the laser during initialization ■ **0 … 9,999 s** Default: **5 s**
LSR_ShutterDelayConst	Shutter delay of the laser (= delay time for starting the laser switching actions before the taught point). ■ **-10,000 ms … +9,999 ms** The value must be determined empirically. Default: **30 ms**
LSR_ShutterOff	Delay time at end of welding, additional to LSR_ShutterDelayConst This value is added to the laser shutter delay LSR_ShutterDelayConst if the laser is deactivated with the instruction **Deactivate process**. ■ **-10,000 ms … +9,999 ms** Default: **0 ms**

Variable	Description
LSR_ShutterOn	Delay time at start of welding, additional to LSR_ShutterDelayConst This value is added to the laser shutter delay LSR_ShutterDelayConst if the laser is activated with the instruction **Activate process**. ■ **-10,000 ms … +9,999 ms** Default: **0 ms**
LSR_TestDelay	Ony relevant if the instruction **Laser test pulse** is used to test the laser power or to determine the focus of the optics. Interval between activating the shielding gas and switching on the laser ■ **0 … 9,999 ms** Default: **0 ms**
LSR_GasScale	Scaling factor for the gas pressure ■ **1 … 65,535** Default: **65,535**
S_Int_Cycl	Submit watchdog pulse duration This variable can be used together with the output S_Int_Flag to monitor whether the submit interpreter is running cyclically. The monitoring only works usefully if the output S_Int_Flag is continuously TRUE. To achieve this, the value of S_Int_Cycl must be a little higher than the cycle time of the SPS.SUB program. ■ **1 … 9,999 ms** Default: **0.048 ms**
LSR_InitGasDly	Delay with which the gas is initialized ■ **-2,000 ms … +2,000 ms** Default: **20 ms**
LSR_GasCheckPressure	Only relevant if a proportional gas valve is used (LSR_PropGasValve = TRUE). Gas pressure used when checking the process or cutting gases during initialization. The range of values depends on the valve used. Default: **10 bar**
LSR_GasDlySwi	Delay on triggering the instruction **Switch gas**. The gas is activated or deactivated after a delay. ■ **-2,000 ms … +2,000 ms** Default: **20 ms**
LSR_TimeToAvoidGasPress	Wait time for the robot controller in order to eliminate the back-pressure in the gas line. Corresponds to the gas preflow time on switching on the laser when the laser is restarted after a fault. ■ **0 … 9,999 s** **Note**: This wait time is not taken into account in the instruction **Laser test pulse**.

Variable	Description
LSR_Stop_Inspection Time	Standstill monitoring at active laser If the robot is stationary and the laser power is active, the laser is deactivated after the time defined. ■ **0 … 9,999 ms** Default: **400 ms**
PreDelay	Time difference between setting the laser parameters and starting the laser program ■ **0 … 9,999 ms** Default: **0 ms**

11.2 Configuring LaserWeld

11.2.1 LaserWeld: analog inputs/outputs

NOTICE Incorrect configuration of the internal analog channels can result in the laser working with incorrect parameters. Damage to the system may result.

Analog outputs

Outputs 1 to 32 are available.

Output	Description	Default
LSWO_WireFeedHeatChan	Analog channel for the wire heater	8
LSWO_WireFeedChannel	Analog channel for the wirefeeder	9

11.2.2 LaserWeld: signal outputs to the wire feed system

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERWELD GLOBALS

OUTPUTS WIREFEEDER

Signal	Description	Type	$OUT[]
LSWO_WireFeedForward	Manual wire feed via status key enabled/disabled	BOOL	301
LSWO_WireFeedStart	Wire feed enabled/disabled	BOOL	302
LSWO_WireFeedChannel	Analog channel for the wire feed $ANOUT[9]	INT	—
LSWO_WireFeedHeatChan	Analog channel for the wire heater $ANOUT[8]	INT	—
LSWO_WireFeedHeater	Wire heater enabled/disabled	BOOL	304

LASERWELD GLOBALS

WIRE CONTROL --> PLC

Signal	Description	Type	$OUT[]
LSWO_ErrorWireFeeder	Wire feeder error (flag to PLC)	BOOL	315
LSWO_ErrorWireHeat	Wire heater error (flag to PLC)	BOOL	316

11.2.3 LaserWeld: signal inputs from the wire feed system

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERWELD GLOBALS INPUTS WIREFEEDER

Signal	Description	Type	$IN[]
LSWI_WireFeedHeatControl	Wire heater ready	BOOL	1025
LSWI_WireFeedReady	Wire feeder ready	BOOL	1025

11.2.4 LaserWeld: process constants

The specified ranges of values contain the values that will be accepted by the system. They do not, however, constitute a recommendation of which values are useful in practice.

The variables described in this section can be found in the file Lsw_Main.dat in the directory R1\TP\LaserWeld. To display or change the values, select **Display** > **Variable** > **Single** from the main menu.

Variable	Description
LSW_UseWireFeed	Use wire controller. TRUE = Wire controller is used. FALSE = Wire controller is not used. Default: TRUE
LSW_HotWireOption	Use hot wire controller (optional). TRUE = Option is used. FALSE = Option is not used. Default: FALSE
LSW_UseWFDVelCtrld	Activate/deactivate velocity-dependent wire feed. TRUE = Wire feed rate is dependent on the robot velocity. FALSE = Wire feed rate remains constant (at the value entered in the inline form). **Note**: If this variable is modified, the robot controller must be rebooted with a cold start.

Variable	Description
LSW_StaticRedWfdOption	Reduced wire feed rate after welding error (optional) TRUE = The wire feed rate is reduced in the case of a start following a weld fault. FALSE = No reduced wire feed rate in the case of a start following a weld fault Default: FALSE
LSW_WfdDistanceMax	Distance for which the reduced wire feed rate applies when the option LSW_StaticRedWfdOption is TRUE ■ **0 … 9,999 mm** Default: **5 mm**
LSW_ReducedLimitWfdValue	Factor by which the wire feed rate is reduced when the option LSW_StaticRedWfdOption is TRUE. The wire feed rate is increased again when the distance specified in LSW_WfdDistanceMax has been covered. ■ **0 … 100 %** Default: **30 %**
LSW_WireHeatDelayConst	Switch on wire heater after or before the start of the laser. ■ **-9,999 … 0.001 mm**: Wire heater start delayed. ■ **0.001 … 9,999 mm**: Wire heater start brought forward. Default: **0 mm**
LSW_WFD_DELAY	Wire feed trigger delay (set in the option window **Media setting: wire**). ■ **0.001 … 9,999 s** Default: **0 s**
LSW_WireFeedMaximum	Maximum value for wire feed, which can be set in the option window **Media setting: wire** ■ **0 … 9,999 m/min** Default: **25 m/min**
LSW_WireFeedMinimum	Minimum value for wire feed, which can be set in the option window **Media setting: wire** ■ **0 … 9,999 m/min** Default: **0 m/min**
LSW_WireHeatMaximum	Maximum wire temperature ■ **0 … 100 %** Default: **100 %**
LSW_WireHeatMinimum	Minimum wire temperature ■ **0 … 100 %** Default: **0 %**
LSW_WFD_AnalogMinValue	Scaling factor for the minimum wire feed on the analog channel $ANOUT[9] ■ **0.0 … 1.0** Default: **0.0**
LSW_WFD_AnalogMaxValue	Scaling factor for the maximum wire feed on the analog channel $ANOUT[9] ■ **0.0 … 1.0** Default: **1.0**

Variable	Description
LSW_Heat_AnalogMinValue	Scaling factor for the minimum voltage on the analog channel for the wire heater $ANOUT[8] ■ **0.0 … 1.0** Default: **0.0**
LSW_WFD_AnalogMaxValue	Scaling factor for the maximum voltage on the analog channel for the wire heater $ANOUT[8] ■ **0.0 … 1.0** Default: **1.0**

11.3 Configuring LaserCut

11.3.1 LaserCut: analog inputs/outputs

The numbers for inputs/outputs, interrupts, timers and cyclical flags must only be assigned once in the entire robot controller.

NOTICE Incorrect configuration of the internal analog channels can result in the laser working with incorrect parameters. Damage to the system may result.

Analog outputs

Outputs 1 to 32 are available.

Output	Description	Default
LSCO_LscDistance	Analog channel for the working distance of the sensor	5
LSCO_LscTipComp	Analog channel for tip compensation of sensor	6
LSCO_LscProgPos	Analog channel for the programmed position of sensor	7

Timer Timers 1 to 32 are available.

Timer	Description	Default
LSC_TC_PrecPLC	Timer number for the sensor status keys	19

Cycflags

NOTICE If the number of cyclical flags is changed, this may result in a double assignment. Furthermore, the numbers of the cyclical flags for the LaserTech monitoring functions may be overwritten. This can cause damage to the system.

Cycflags 1 to 32 are available.

Cycflag	Description	Default
LSR_CF_GasCtrl	Cycflag number for the sensor monitoring	13

11.3.2 LaserCut: signal outputs to the sensor

Detailed information about the distance sensor and distance controller is contained in the PRECITEC documentation.

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

LASERCUT
GLOBALS

Signal	Description	Type	$OUT[]
LSCO_SnsrWorkdistance2	Workdistance 2*	BOOL	219
LSCO_SnsrWorkdistance3	Workdistance 3*	BOOL	220
LSCO_SnsrLargeRange	Use extended measuring range.	BOOL	221
LSCO_SnsrEnableManual	Enable/disable manual mode of the sensor.	BOOL	217
LSCO_SnsrAuto	Enable/disable manual mode of the sensor.	BOOL	218
LSCO_SnsrHome	Move sensor to programmed position.	BOOL	222
LSCO_SnsrReference	Execute reference run.	BOOL	999
LSCO_SnsrManualUp	Move sensor up.	BOOL	223
LSCO_SnsrManualDown	Move sensor down.	BOOL	224
LSCO_SnsrSlowMotion	Enable slow motion mode.	BOOL	225
LSCO_SnsrDataWord	Internal word for sensor control. Comprises the entire output range.	Word	201 … 232
LSCO_LscDistance	Analog channel for the working distance of the sensor $ANOUT[5]	INT	—
LSCO_LscDistance	Analog channel for tip compensation of the sensor $ANOUT[6]	INT	—
LSCO_LscProgPos	Analog channel for the programmed position of the sensor $ANOUT[7]	INT	—

11.3.3 LaserCut: signal inputs from the sensor

Detailed information about the distance sensor and distance controller is contained in the PRECITEC documentation.

The signals described in this section can be found in the file …R1\System\$CONFIG.DAT. To adapt the values, the file must be edited.

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GLOBALS

Signal	Description	Type	$IN[]
LSCI_SnsrOutOfRange	Sensor is outside of the measuring range.	BOOL	213
LSCI_SnsrCollision	Sensor collision detection	BOOL	214
LSCI_SnsrPosReached	Sensor position reached	BOOL	215
LSCI_SnsrNoError	No sensor error	BOOL	216
LSCI_SnsrReady	Sensor is ready.	BOOL	217
LSCI_SnsrRefErr	Sensor reference error	BOOL	443
LSCI_SnsrCableCut	Monitoring of the sensor cable (cable break)	BOOL	1024

11.3.4 LaserCut: process constants

The specified ranges of values contain the values that will be accepted by the system. They do not, however, constitute a recommendation of which values are useful in practice.

The variables described in this section can be found in the file Lsc_Main.dat in the directory R1\TP\LaserCut. To display or change the values, select **Display** > **Variable** > **Single** from the main menu.

Variable	Description
LSC_AnaCutDistance	The cutting distance set in the inline form **Switch sensor** is transferred as an analog value. (Unit: 1/10 mm) TRUE = Cutting distance is transferred as an analog value. FALSE = Cutting distance is transferred via a program number. Default: FALSE **Note**: If this variable is modified, the robot controller must be rebooted with a cold start.
LSC_AnaCutScale	Only relevant if the cutting distance is transferred as an analog value (LSC_AnaCutDistance = TRUE) Scaling of the cutting distance Default: **1/655.35**
LSC_ProgPos	Only relevant if the cutting distance is transferred as an analog value (LSC_AnaCutDistance = TRUE) Programmed position of the sensor (= home position of the sensor). Refers to the zero position of the sensor. ■ **3 … 9,999** Unit: 1/10 mm Default: **60**
LSC_DefProgPos	Only relevant if the cutting distance is transferred as an analog value (LSC_AnaCutDistance = TRUE) Programmed position of the sensor on start of control ■ **0 … 300** Unit: 1/10 mm Default: **150**
LSC_MaxProgPos	Only relevant if the cutting distance is transferred as an analog value (LSC_AnaCutDistance = TRUE) Maximum programmed position of the sensor ■ **0 … 300** Unit: 1/10 mm Default: **300**
LSC_TipComp1	Maximum permissible contact duration during cutting (tip compensation time 1) ■ **1 … 9,999 ms** Default: **250 ms**

Variable	Description
LSC_TipComp2	Maximum permissible contact duration during piercing (tip compensation time 2) ■ **1 … 9,999 ms** Default: **250 ms**
LSC_GasRinseTime	Gas flow time during gas change after piercing ■ **1 … 9,999 ms** Default: **2000 ms**

12 KUKA Service

12.1 Requesting support

Introduction

This documentation provides information on operation and operator control, and provides assistance with troubleshooting. For further assistance, please contact your local KUKA subsidiary.

Information

The following information is required for processing a support request:

- Model and serial number of the manipulator
- Model and serial number of the controller
- Model and serial number of the linear unit (if present)
- Model and serial number of the energy supply system (if present)
- Version of the control software
- Optional software or modifications
- Archive of the software
- Application used
- External axes used
- Description of the problem, duration and frequency of the fault

12.2 KUKA Customer Support

Availability

KUKA Customer Support is available in many countries. Please do not hesitate to contact us if you have any questions.

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